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[*Photo: The Tea Bureau, London*

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VOLUME 6, No. 11 NOVEMBER 1954

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WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

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Editorial Comment

World weather

THE current year has been remarkable for the inclement character of the weather experienced not only in Europe, but in many other parts of the Northern Hemisphere. In England, the summer has been remarkable for the persistent intensity of the rainfall, which has caused many a headache to farmers faced with the difficulty of getting in their corn and hay crops. True that at the end of August and in early September a few days' fine weather enabled progress to be made with the harvest, but the hopes thereby inspired that Jupiter Pluvius had so far relented as to allow a badly wanted spell of fine weather to supervene were rudely dashed after a few days when the regime of showers with occasional bright intervals to which the British public had become accustomed returned with redoubled vigour.

In many parts of Europe, the picture has been similar, while in other parts of the world equally unfavourable conditions have prevailed. In Northern India and Eastern Pakistan, for example, there have been torrential rains followed by serious floods over a widespread area, resulting in serious crop losses. The floods are stated to have affected about 20 million people in the Ganges and Brahmaputra valleys in a belt over 1,000 miles long, most of the districts concerned having been continuously under water since the end of July to the end of August.

Full information concerning the damage to the tea and jute crops is not yet available owing to disruption of communications, but it is known to be considerable. In East Africa, excessive rains have been reported from Kenya, the season having been regarded by many as the wettest within recent memory.

On the other side of the Atlantic, equally unpropitious conditions have prevailed along the Atlantic seaboard owing to a series of hurricanes which took their rise in the Caribbean area, which, instead of, as is more usual, recurving in the latitude of Florida and dissipating their strength over the North Atlantic Ocean, continued their courses northwards, laying a trail of havoc and desolation in their wake in the states of New England and the maritime provinces of Canada.

Turning to North Africa, another untoward event has been the series of earthquake shocks which have wrecked the town of Orleansville in Algeria, for, although this event can perhaps hardly be classed as related to weather conditions, nevertheless it forms part of the picture of devastation due to natural causes which will make the year 1954 memorable.

In the minds of many of the non-scientific portion of the population, the tendency has arisen to ask whether all these undesirable phenomena may not be attributable to preoccupation on the part of some of the great powers with atomic explosions, which have of late years been increasingly numerous. It is perhaps not remarkable that this should be the case in the face of Prof. Adrian's gloomy prognostication in his presidential address to the British Association, that a series of uncontrolled atomic explosions, such as might occur in the event of the outbreak of yet another world war, would probably result in making the globe, or, at any rate, large parts of it uninhabitable for the human race by reason of the existence of active atomic residues, the assumption being apparently that all these untoward and unexplained meteorological phenomena may be in the nature of premonitory symptoms arising from a similar cause.

Wheat stocks and prices

IN July last, world stocks of wheat in the main producing countries were of record dimensions, while prices had sagged to the low level of $1.95 per bushel. Since then world prices have risen perceptibly to round about $2.15 per bushel. The chief reasons for the improvement was the substantial drop in estimated wheat production in the main producing countries and the bad season in Europe. Poor European grain harvests have strengthened the demand for North American grain; another factor is that the stocks of hard wheat in Britain built up by the Ministry of Food have now been dispersed.

It is as yet too early to say how far the renewed demand for North American wheat will extend. Stocks of American wheat remain undiminished, but supplies from the Argentine are apparently lower than in previous years, while crops in the United States and Canada are likely to be substantially smaller. In the case of Canada, one of the factors operative apparently is extensive rust damage, while the harvest is very late. It is believed currently that the new crop may be 100 million bushels lower than that of the previous year.

The total world carry-over stocks of wheat and wheat flour on July 1 last were estimated by Broomhall to be 211 million quarters, as compared with 136 millions in 1953 and 63 millions in 1952. It seems, therefore, that there is every prospect that at least a temporary halt may be called to the menacing growth of wheat stocks which has been apparent of recent years. But this in itself is by no means sufficient, for it carries no guarantee that further accumulations may not recur in subsequent years.

The question of the disposal of surplus agricultural commodities has been occupying the attention of the Committee on Commodity Problems of FAO at its session in Rome during June last. One of the general conclusions at which they arrived was that measures to dispose of surpluses already in existence will not solve the surplus problem unless parallel measures are taken to avoid the accumulation of new surpluses. The applicability of this finding to the position in regard to world wheat stocks needs no emphasis. The further conclusion of the committee, that in general the adjustment of supply and demand should be sought in the expansion of consumption rather than the reduction of production, and that output reductions, if they are imperative, should be brought about by 'economic disincentives' —whatever they may be—'rather than by physical restrictions, however desirable it may sound, seems in an imperfect world to be somewhat in the nature of a counsel of perfection.

The desert locust

THIS month a meeting of 21 governments has been convened by the Director-General of FAO for the purpose of discussing the desert locust position. The main object of the meeting is to set up a special working party on desert locust control and to plan the 1954-55 campaign against the present locust plague, which is one of the most severe since locust control on an international basis became a practical proposition.

In the invitation to attend the meeting, Dr. Cardon pointed out that the need to achieve the most practical form of organisation for controlling the outbreak is a matter for urgency; it is also urgent that means should be found for making available additional resources for the prosecution of the campaign.

It is agreed that, while the campaign carried out during 1953-54 showed an improvement on those of earlier years and there was evidence of a better spirit of co-operation, the efforts were inadequate to secure completely effective control of locust breeding in the Arabian peninsula, while they were started too late in the season. Next year, it is urgently desirable that an earlier start should be made and that considerably increased resources should be available for operations. It appears, in fact, that no fully effective campaign can be planned unless the governments of the countries affected increase their contributions. The Arabian peninsula is the key region in the breeding and multiplication of the locust swarms which attack vast stretches of territory in Asia and Africa; previous work has already shown that breeding can be controlled and in the Arabian peninsula locust control operations are, in fact, an insurance for all the governments within the area liable to be affected by the plague against the invasion of their own territories.

It is, therefore, strongly to be hoped that, as the result of this meeting, means will be found to strengthen the work of desert locust control in this region.

A jubilee

THE jubilee conference of the Association of Applied Biologists held in September, of which an account appears on another page of this issue, was an event of more than ordinary significance, inasmuch as it marks the manner in which biological science in its application to industry, and more especially to agriculture, has advanced during the present century.

The move to found the association was the result of the enthusiasm of a handful of workers in biological science, eight of whom in November 1904 launched it under the title of the Association of Economic Biologists. Its title was changed to its present form in 1934.

At the time of its foundation, the conception of research into problems of applied biology could scarcely be said to have any real existence; certainly any sense of its importance was almost entirely lacking in most countries either by governments or university authorities.

It was, for example, considered to have been doubtfully wise statesmanship when, on the recommendation of the West India Royal Commission of 1897, the British Government was moved in 1900 to set up in the West Indies, at the expense of the British taxpayer, a so-called department of scientific agriculture, the headquarters staff of which included one entomologist and one plant pathologist, in an attempt to alleviate the difficulties of the West Indian sugar industry. Actually, these were the first appointments of this kind to be made in the British Empire and were the forerunners of the present considerable provision in this regard.

In the years which followed, the association still continued to be a voice calling in the wilderness, but under the presidentships of a number of distinguished biologists, such as the late Sir Arthur Shipley, J. V. Theobald and others, its influence steadily grew and the doctrines which it preached gained increasing acceptance.

In 1914, it launched its own journal, the *Annals of Applied Biology*, while during the period which preceded the outbreak of the 1939-45 war its membership, work and activities greatly expanded as the recognition and acceptance of the essential importance of applied biology expanded.

The meeting itself proved to be a fitting mark of the occasion it was designed to commemorate both in regard to the number and eminence of the delegates from many countries who attended it, which included such well-known international figures as Prof. van Slogteren from the Netherlands, Dr. E. Gram from Denmark, Prof. Burstrom from Sweden, Prof. Stakman, Dr. K. Starr Chester and Dr. A. E. Dimond from the U.S.A., and Dr. Hubert Martin from Canada, and also by reason of the interest of many of the papers which were presented.

Who knows what new and startling developments may have taken place in the application of the biological sciences to industry and agriculture by the time the centenary of the foundation of the association falls due to be held?

Ecological chemistry

IN the course of the conference, one of the discourses which attracted much attention was one by Dr. Hubert Martin, now Director of the Science Service Laboratory at Ontario, Canada, and for many years attached to Long Ashton Experiment Station in the United Kingdom. Dr. Martin, speaking on the subject of problems in the application of chemistry to crop protection, had occasion to mention the influence of plants in ecological association on one another. Attention was first directed to this subject by the classical work of S. U. Pickering at Woburn in the first decade of the present century, when he demonstrated the effect of one plant on another growing in pots and applied the results to the effect which grass has on fruit trees, the assumption being that the depressing effect on growth recorded might be due to the excretion of chemical substances from the roots of the plants. This work was for many years largely disregarded, but Dr. Martin, speaking of the effects of other substances, such as plant hormones, on plant growth, indicated that the matter was again receiving attention and suggested that in due course a new line of research and investigation might be opened up having regard to the effect of substances excreted from the roots of plants on their neighbours in the field. For this, he suggested the name 'ecological chemistry.' The suggestion is certainly an in-

triguing one and it may be that further investigations will lead to unexpected developments.

A point that emerges is the considerable and close acquaintance which modern biologists concerned with the control of pests, diseases and weeds and the breeding of new plant forms must need possess with organic chemistry. Gone are the days when the biologist could cheerfully classify such subjects as organic chemistry, nuclear physics and higher mathematics as things with which they had no concern; today, the successful research worker in many aspects of applied biology must have at least more than a nodding acquaintance with a number of aspects of the latter sciences. Of late years, the advances of knowledge in all these sciences have been so very considerable that it is probably beyond human capacity for one individual to be fully informed about all their recent developments. But at least the basic training of the biological scientist must be directed to endow him with the mental equipment which will enable him to acquire without undue difficulty knowledge regarding those aspects of related sciences necessary to enable him to carry on his biological work.

Fertilisers in bulk?

FOR some years in America, the application of fertilisers by bulk spreading has been slowly but persistently developing. Its economics are not unattractive. The fertiliser is loaded at the factory on to the spreading lorry—the costs of bagging and storage and fertiliser conditioning are eliminated. For the fertiliser industry, the idea is also attractive insofar as it encourages application during the autumn and thus helps to reduce the enormous peak demand of the spring. The natural query is, of course, whether fertiliser thus applied is as efficient in the soil. The advantages of placement cannot be gained, for spreading must generally take the form of broadcasting. However, placement benefits must be looked upon as short-term means of economy and there is something to be said for the counter-argument that placement merely discards the longer-term virtues of residual fertility. For suitable fertilisers and crops, *e.g.* a predominantly phosphatic and potassic fertiliser for grassland, bulk spreading is hardly open to criticism. There is nothing novel about the method of application in Britain, for it is used for lime and often for salt. Contract spreading facilities are well organised, but they have so far had little association with fertilisers here.

In America, bulk spreading is making most progress in the midwest states, and a recent prediction goes as far as saying that in some states half the fertilisers used may eventually be applied in this way. One practical limitation would seem to be that the contract lorries used cannot generally apply less than about 2 cwt. per acre; however, useful fertiliser applications generally have a higher rate than this, and it may only be the modern high-analysis fertilisers that suffer from this restriction. Winter spreading is handicapped by the obvious soft ground difficulty; the autumn, before the ground has lost its summer hardness, is the natural season. It would certainly seem that more thought and attention should be given to this method of fertiliser usage in countries other than the United States.

Dual control

ONE of the papers in the latest report from Long Ashton (H. G. H. Kearns and N. G. Morgan) puts forward the most interesting suggestion that DDT and gamma-BHC might be used in combination for spring orchard spraying. The use of each separately in the place of winter washing is already a modern and expanding practice, but results tend to vary. Aphid control by DDT is critically dependent upon good timing; this seems less true of gamma-BHC, which, whether wettable powders or emulsions are used, gives excellent control over aphids and apple sucker without precise timing and even without meticulous attention to thoroughness of spraying. On the other hand, gamma-BHC is not generally as effective in controlling caterpillar or capsids; good control without a narrow dependence upon timing and at low rates of application is given by DDT. It is, therefore, a logical step to combine the two in the hope that a conjoint spray will provide the best of both without carrying the limitations of either.

No special difficulty has been found in preparing an emulsified common solution of DDT and gamma-BHC. A wetting agent is an essential addition. The emulsion stores well for long periods in rust-proof containers. The spray can be applied to apples at any stage just after bud burst up to the pink bud stage, and it can be combined with lime sulphur spraying. Further field development work is certainly required before it can be claimed that this ' modern marriage ' is as successful in practice as it is in theory, but at least the prospects seem very promising. To some extent the development of DDT and BHC has been competitive; this has not been a consequence of commercial interest, for most manufacturers offer both materials in various ranges of formulation—rather, there has been a tendency to think in terms of one or the other and the simple improvement of using both together has been overlooked. The Long Ashton contribution might well prove to be the historical advance that truly enables fruit growers to reduce and cheapen their annual spraying programmes.

Drift from the land?

PROF. AUSTIN ROBINSON'S presidential address to the economics section of the British Association dealt thoughtfully and somewhat gloomily with the balance between agriculture and industrialism in the British economy. His long-term forecast that Britain must eventually move back towards the older balance in which agriculture was more dominant has been criticised as too pessimistic. However, he showed that with industrialism's rise the proportional effort of agriculture has steadily receded. One hundred years ago, 20 % of the population was engaged in agriculture; now it is rather less than 5 %. The ratio of productivity in agriculture and industry was 1.07 in 1870; this had dropped to 0.6 by 1951. This means—at any rate, in the coldest measure of economics, market prices—that the average agricultural worker is nationally worth only about two-thirds the average industrial worker. It means also that the gradual drift from the land over the past hundred years has been economically sound!

But to all this the background has been Britain's industrial supremacy *in the 19th century*—and the background has altered. Britain no longer possesses unique advantages over other countries; indeed, to some extent disadvantages have entered the scene. Other countries now develop technical industries just as vigorously as ourselves and in some cases more vigorously; countries which used to import all their factory-made requirements now have their own youthful industries. How long will it be economically profitable to devote resources to manufacturing for export and to import a sizable part of our diet with the currency obtained? Prof. Robinson believes that ultimately Britain will have to move towards the farm-factory balance of Germany, where 16% of her male population is engaged in agriculture and only about a fifth of her food imported. This is, of course, the view of an economist and not an agriculturist and how far such an increase in food output from limited land resources could be secured without making food too dear to buy is open to practical argument.

It is strange that this theme should be aired at a time when food rationing has ended and when industry and exports are enjoying a ' boom.' But it might be remembered that since 1939 war conditions, post-war scarcity conditions and fear-of-war conditions have determined the demand for British industry's output. The test of intense competition in a contracting world market—a depression—has yet to be faced. Prof. Robinson's pessimism may turn out to be realism, even his fear that ' events may continue to require us to make changes faster than a free and smoothly working economy can easily carry them through.'

The demand for British farm machinery

IN Britain, the demand for agricultural tractors, machinery and equipment is reported to have risen of late months more steeply than at any time in the past two years. Factories concerned with their production are working to capacity and Britain's position as a world exporter has been strengthened by the fact that during the first five months of 1954 there was a 25% increase in shipments as compared with 1953.

Competition from foreign manufacturers in Europe is considerable, but so far it continues to suffer from the handicap of a small volume output. On the other hand, the openings for imported machinery and equipment in Continental countries is showing a tendency to contract and as manufacture there increases, distribution becomes better organised and competition keener, this tendency seems bound to become more pronounced.

In Britain, the changes in the position are indicated by the recent census carried out by the Ministry of Agriculture. Between 1952 and 1954, the number of tractors on farms increased by 18% and combine harvesters by 28%, while in the past two years the number of pick-up balers has shown a steep rise of 75%. Modern developments in the technique of weed control are also responsible for a great increase in the number of crop-spraying machines, this having almost doubled between 1952 and 1954.

The recent wet summer has served to emphasise directions in which mechanisation can be of benefit under adverse conditions, a fact which manufacturers of farm machinery have not been slow to realise; the combine harvester, the farm drier, the pick-up baler and the foreloader can be invaluable aids to the harassed farmer in bringing in his corn harvest which has been badly laid by wind and rain or in dealing with his hay crop, which cannot be matured by reason of inclement weather conditions. Moreover, in such conditions it may be by far the best policy to turn to silage in replacement of hay, and here mechanical aids can be of infinite assistance in preparing and laying up the product.

Another jubilee

THIS time a diamond one, the occasion being the 60th year of publication of the journal *Agriculture*, the official organ of the English Ministry of Agriculture. To mark the occasion, the Ministry has issued a special diamond jubilee number of the publication; this is an attractively got up production containing a series of articles by various eminent authorities reviewing some of the great and revolutionary changes which have taken place in British farming and the official attitude towards it during the past 60 years. The issue is prefaced with a foreword by the Minister of Agriculture and Fisheries, the Rt. Hon. D. Heathcoat Amory, who refers to the genesis of the journal as a means of giving publicity to information of interest to agriculturists, which was available to the Board of Agriculture and Fisheries, as the Ministry was then designated.

How very scanty were the resources which could be made available to assist farmers at that time can be gauged from many of the articles written in retrospective vein, which the number contains. As Prof. Stephen Watson points out, the whole system of agricultural research as we know it has been developed during the existence of the journal. It is true that Rothamsted was founded in 1843 and in its early days was financed by Sir J. B. Lawes entirely from his private purse, while a certain amount of valuable research was carried out by private farmers and recorded in the journals of the Royal Agricultural Society and the Royal Highland Agricultural Society, as well as by the Royal Agricultural College at Cirencester, the oldest of the English agricultural colleges. But, apart from these exiguous resources, there was nothing available from which detached and reliable advice could be obtained.

At that time, moreover, British agriculture had almost touched the nadir of the depression which had overspread the English scene since the 1870s and which persisted, with only a temporary improvement during and immediately after the first world war, until the farming renaissance had its birth in the 1940s. Since then what a change, the most outstanding feature being, we suppose, the amazing spread of mechanisation in the farms of England. Today, there must be full many a farmer in Britain who wishes that, like the author of one of the articles in this issue, he could take his grandfather round the countryside today and watch the astonishment of his reincarnated progenitor at the changes in farming methods which have come about in the past 15 years.

The Development of Spraying Machinery

Part 1—Principles

R. J. COURSHEE, B.Sc.

This is the first of a series of three articles dealing with the development of spraying machinery. It is concerned with the general principles involved. The second and third articles, concerned with the testing of the efficiency and the commercial development of such machinery will appear in our next two issues.

AT a recent meeting where spraying machinery was being discussed, a speaker said, jocularly, that to him it was only important that a sprayer should start and having started should continue to go. That *mechanical reliability* took such priority indicates that the *performance* of the sprayer was adequate. And it probably was since he was thinking of spraying machines of the kind in which the crop is saturated with a dilute aqueous solution of the chemical to be applied. Using this method, it is successful and so easy if a first attempt fails to spray more and more solution until the application can be considered sufficiently thorough (ignoring the large proportion of the chemical wasted).

Performance of machines

However, this liberal use of chemicals and water is very rarely possible and since the safeguard that it ensures is absent in more economical spraying methods we have often to be concerned with *how* a machine performs as well as *whether* it performs.

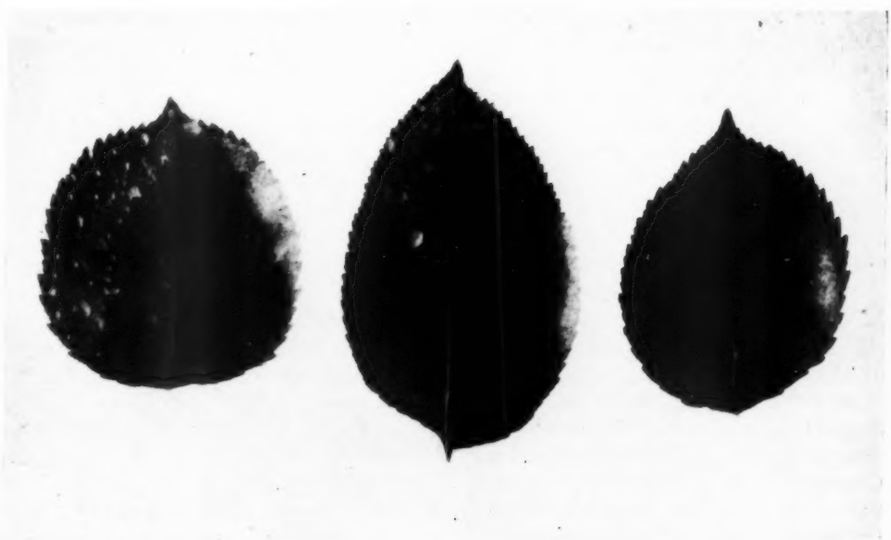
A spraying machine is usually used for the purpose of applying a relatively small quantity of liquid in a prescribed manner on a crop. The chemical contained in the liquids, if they are applied properly, kill the unwanted pest without harming the plant. So we consider a sprayer is doing its job if it is placing the chemical where it is needed.

From this viewpoint, sprayers form one link in a chain, forged with the eventual aim of increasing crop yield and its owner's income, which embraces the chemical, the pest and its relationship to the insect population, the crop and the spraying machine, in fact all the circumstances relevant to killing a particular bug on a certain piece of vegetation.

The sprayer tends to be the last item to be considered. It is made in order to apply chemicals in the manner which has been shown to be suitable. So, those who make them act in accordance with the instructions of the entomologist. Since, however, he prepares these instructions as a result of working in a variety of fashions with the application equipment at his disposal, it is clear that the deposits found to be suitable are relevant only to the method of application with which he was experimenting. He should, therefore, bear in mind the fact that quite different techniques, perhaps allied to different chemicals, may be better. We occasionally find the reciprocal situation where circumstances require a certain type of sprayer and a suitable chemical deposit has to be found for it. Aircraft spraying of many field crops is an example where the machine stimulated the search for chemicals successful at the small volume application rates possible. Much more often though machine makers wait upon the biological work which is a necessary preliminary to their own. Our basic assumption is that a good spraying machine is one which applies the correct dose defined in this manner economically and without fail.

Dose specification

For most agricultural purposes, a certain deposit of chemical on all or a particular part of the surface of the vegetation is needed. This concept of there being a static suitable dose is an approximation. Considering only surface deposits, we wish to know, firstly, how much of the chemical is required per unit area of surface and also how much more can be applied without causing any harm. However well it is distributed an insufficient quantity is by definition inadequate. But even if enough is present on a leaf we need to know how it is spread over it—whether it is mainly in one patch at the leaf tip, as is sometimes the case with run-off spraying, or whether it is spread more or less regularly on either the top or the bottom surface or both. Measures of this are,



Run-off spray deposits of lead arsenate showing excessive dose on some parts of the leaf and sprayed with a hand lance at 300 gal. per acre

firstly, the fraction of leaf surface actually covered with spray, and secondly, the size of the bare intervals between separate patches of spray deposit. Both are measures of the likelihood of, for example, an insect being able to feed on a clean patch of leaf. We have to bear in mind, however, that the initial pattern of deposition may be radically altered subsequently by a variety of mechanisms some of which are instanced below.

The detailed consideration of what I call the fine structure of the deposit is of extreme importance when small volumes (approximately less than 200 micrograms per square centimetre of a leaf) of concentrated spray are being applied. They also, however, have considerable significance when application rates of several hundred gallons per acre are made on trees. The cover obtained then is only 100% on a small fraction of the leaf area and decreases to zero on a few leaves so that on a large proportion of the crop the cover is a long way below the oft-quoted 100% cover reputed to characterise run-off spraying.

Examples of specification of dose

Some examples are listed here to illustrate how widely the dose can and does vary in its fine structure according to the purpose in hand.

Consider, for example, weedkillers. On the one hand, we have chemicals of the hormone type, which appear to be spread by the plant throughout its system and therefore can be applied as large drops widely spaced and still be as effective as when the same quantity of active material is applied as small drops of either low or high concentration. The converse is true of contact herbicides. Since the plant tissues are destroyed over an area only a little larger than the zone actually seen to be contaminated, we find that a more nearly complete cover of the vegetation is needed. (The cover increases for a given dose of active material if either the drop size or the concentration are decreased.)

Fungicides also supply interesting examples of widely differing deposits. It is common commercial practice in this country to apply 200 to 400 gal. per acre of 1% to 2% lime sulphur to control apple scab. In Holland, a much smaller volume of a solution 10 times as strong is used and Moore at East Malling has applied only a few gallons of a solution 50 to 100 times as strong successfully. Measurements of the leaves sprayed in this last way show that only 1% to 5% of their surface is actually covered with spray deposits, even when using a drop size as small as 70 microns; there are large bare patches quite devoid of spray and yet the tiny fungus spores cannot germinate on them. It is not clear what the inhibiting factor in the bare zones is, although there are many theories, but, since the fungus needs moisture to germinate, that same moisture film may cause a sufficient contamination of the intermediate areas to kill the spores. On the other hand, the 'sulphur atmosphere' which can be smelt in a well-sprayed orchard on a damp, still morning may be the toxic agent.

Copper used against potato late blight can only be transferred from the place where it is deposited to the zones between spray particles in solution (it cannot form a gas). It is not known, however, whether this translocation occurs externally in dew or internally. There is the peculiar ability for overleaf deposits to prevent germination on the underside of the leaf, leading to the current neglect of the use of drop leg nozzles to spray the underside of leaves of potatoes. The situation is not clear, however, since overleaf sprays do give a little underleaf cover, particularly if the correct nozzles and disposition of them are used, which may, nevertheless, be sufficient to give protection.

All such factors might indicate to us which type of machine may be used successfully.

A more radical change of application equipment is usually involved than the simple omission of drop-leg nozzles. An example studied of two pests on the same crop may be mentioned. One is active and mobile and lives on top of the leaves and is consequently an ideal target for drift methods of application (which are valuable because of their high speed of working), since the insect will eventually move over the spray deposit. On the other hand, a second insect is nearly static, very small and lives on the underside of the leaf and few targets are less likely to be killed by a contact insecticide applied by drifting. Accordingly, a complete change of application method may be necessitated from drift sprayers to placement sprayers to get on the underside of the leaf and from low-volume to high-volume applications to get the required nearly complete cover. But completeness of cover must be defined quantitatively, since 1% cover—which is quite likely to be adequate—can be obtained with a concentrate spray, whereas a 10% cover most certainly cannot.

Quantitative spraying

So, in addition to the general form in qualitative terms describing the spray deposit, a quantitative statement of requirements is usually essential. Spraying is expensive and should be done in the manner which is most economical if, and only if, the likely degree of infestation is sufficient to warrant the expenditure either as a precautionary measure or to eradicate a pest already present.

It is very much more expensive to exterminate a pest completely than to reduce its incidence to perfectly tolerable levels. Toleration depends mainly upon the type of damage; that is to say, moderately large weed populations can be tolerated in competition with a growing crop which would, on the other hand, be disastrous among seedlings less able to fend for themselves and the type of damage caused may change from competition for nutrients to an actual killing of some of the crop plants. Complete destruction is required of low population-high damage pests. Disease vectors, for example, where each vector may infect a large number of plants, are insect problems which are not easily and cheaply combated by chemical control, except perhaps with fully systemic insecticides (although even these appear to allow an insect to infect a plant in the short time it feeds before it dies). Tsetse fly (of one kind) are another example: because of the large amount of damage caused by a few flies it may be necessary to spray a population of 1,000 per square mile, *i.e.* one or two tiny flies per acre. This extreme wastefulness of insecticide nevertheless provides one of the few economic control methods.

The circumstances

The biological problem will probably determine to a large extent the type of application method used, but a variety of environmental factors will both influence this choice and also determine which of the available application equipment using this method is most suitable.

When making spraying machines in response to specific requests, we consider the effect of the circumstances in detail if possible. Apart from the location of the pest, the way in which the chemical used kills it or, in the case of a fungus pest, prevents its germination and the row spacing of the crops, for example, we consider the situation generally under the headings: crop, terrain, people, pest, toxin and weather. To take an example: how will the radiation intensity influence either the dispersion or rate of evaporation of a coarse aerosol? If there is a likelihood of important losses from this cause, drift spraying or even the spraying of high concentrations of water solutions may not be possible.

The people and their economic resources may decree that for one purpose a relatively complex air-blast machine can be used and maintained, whereas occasionally

a shilling spraying machine (*i.e.* hand syringe) may be all that can be bought. In the latter case, there are two points to be mentioned. Firstly, even a hand syringe can be a good one and can be designed to suit moderately well the purpose for which it is being used. Secondly, it is bad economics to buy a cheap sprayer where a more expensive one could do a better job if you pay for chemicals, since these cost far more than the price of the machine. So these very cheap hand syringes (which are not up to the standard of compression sprayers, for example) are best suited for using home-grown, *i.e.* cheap, vegetable toxins.

Machine simplicity and mechanical reliability may not in all circumstances be as high as would be ideal. More mechanically-minded people may prefer a more efficient machine which is a little more complex or choose to drift spray, a technique which is quick, but to be economic requires closer and more thoughtful control of the application than boom spraying. Mechanical reliability may be achieved by good design or more commonly by underrating components so that a large load imposed through bad handling does not break anything. Thus a good tractor driver makes do with a drawbar of the correct strength, whereas a bad one, particularly using a crawler tractor, would need one very much stronger and in a sense much more ' reliable ' than the proper one if he is to avoid breaking it.

It would need a genius to balance successfully the conflicting aims of the large number of factors which should be considered. But we think it is necessary to know all of them so that they can be allotted some sort of priority and we can begin to incorporate as many of the most important as possible into a sprayer. A peasant farmer with few or no cash crops rates cheapness highly, whereas a contract sprayer spraying several thousands of acres in a season and disposing of some thousands of pounds' worth of chemicals must, above all else, ensure that the chemical is used as economically as possible, and the price of the best machine available to do this job is of little significance; best in this context means the most efficient use of the chemicals to be applied, since these are nearly always by far the most costly part of the spraying operation.

Progress in the Mechanisation of Farming in the Colonial Territories

In a recent number of *Tropical Agriculture*, the journal of the Imperial College of Tropical Agriculture, an interesting article appeared with the above title by Mr. J. E. Mayne, B.Sc., Secretary of the Colonial Agricultural Machinery Advisory Committee, who during 1953 undertook a fact-finding tour in East Africa with the object of collecting information regarding experience in these territories with the use of machinery in farming and the scope and need for its extension.

In his paper, Mr. Mayne points out that mechanisation in agriculture is a facet of the broader field of economics. It should not be confused with agricultural engineering, since the latter may be said to cover all aspects of engineering—mechanical, civil and electrical—in connection with agriculture. Mechanisation, on the other hand, is concerned only with the application and management of machines in crop or livestock production.

Of late years, increasing attention has been devoted to the possibility of increasing mechanisation in tropical countries and the attempt was made to describe some of the progress in introducing modern mass-produced machinery into tropical farming in British Africa.

Working conditions

The conditions under which agricultural machines are required to work in East Africa vary from saturated soils at sea level to wide-open cereal-growing uplands at 10,000 ft. elevation. This gives a very wide range of climatic conditions in addition to a great variety of agricultural soils and crops; it is to be remembered that a tractor's performance falls off at high altitude.

It is probable that less than 20,000 tractors are at work in all the British Colonial territories; total value of imports of tractors and machinery into them during the past few years are as under:

1938	.. ..	£379,000
1949	.. ..	£7,305,000
1950	.. ..	£5,274,000

Post-war experience indicates that a major problem is the shortage of first-class trained and experienced staff. This difficulty has been aggravated by the fact that it has only been possible to arrange training facilities along with the establishment of projects for mechanisation instead of in advance of them.

Conclusions

During the course of his tour, Mr. Mayne visited Northern Rhodesia, Swaziland, Nyasaland, Tanganyika, Zanzibar, Kenya and Uganda. As a result, he drew the following conclusions:

1. There is little evidence of an immediate and general need for a serious modification of existing machinery or for the design of new types of machinery, although there are certain important exceptions.

2. There is scope for the further development of British-made machinery for weed control, maize growing and certain cultivation operations.

3. The products of some American manufacturers are less subject to breakage under rough colonial conditions than are machines coming from some other sources.

4. In planning many mechanisation schemes in Africa the cost has often been under-estimated and machine performance over-estimated. There is a lack of basic data for planning co-ordinated experiments in mechanisation.

5. There is a definite need for facilities for testing machinery in the colonies.

6. The territorial Departments of Agriculture in Africa are very much alive to the possibilities of mechanisation and excellent progress is being made in spite of difficulties and staff shortages. Some departments have developed mechanisation to a high degree of efficiency.

Seed Analysts' Training

Nearly 60 seed analysts from 20 countries throughout the world met in Cambridge from June 21 to July 2 for a practical course of instruction in interpreting the new rules of the International Seed Testing Association (I.S.T.A.) for seed analysis, which came into operation on July 1, 1954. This course, which was one of the projects of the European Productivity Agency, was held at the official seed testing station at Cambridge by permission of the Director and the Council of the National Institute of Agricultural Botany. The course consisted of lectures, discussions and practical instruction on the main section of the revised international rules for seed testing. The lecturers included Dr. Leggatt, of Canada, chairman of the I.S.T.A. sampling and bulking committee, and Dr. O. L. Justice (United States), chairman of the I.S.T.A. rules committee.

The Cotton Industry of India

S. RAMANATH

Cotton has been grown in India probably longer than in any other country. The following article gives a concise account of the history of the industry and the present position of cotton production in India.

THE cultivation of cotton and its manufacture into textiles has been practised in India since pre-historic times. The most ancient cotton fabrics are those excavated from the ruins of Mohanjo-Daro, in Sind, which date back to 3000 B.C. It was the fame of the Indian calicos, mulls and silks that attracted the Western nations to India. Marco Polo (13 century A.D.) observed that ' Masulipatam produced the finest and the most beautiful cottons to be found in any part of the world.'

Exports

The import of cotton cloth into England and some European countries in the 17th and early 18th centuries was so great that the drain of wealth from those countries into India perturbed the minds of politicians in those countries. It ultimately led to the beginning of the cotton spinning and weaving industry in some countries of Europe. The export trade in cotton goods in India commenced during the time of Alexander the Great, who established land and sea trade routes, and continued till the commencement of the 19th century.

The 18th century, which witnessed the beginning of the consolidation of British power in India, may be said to be the turning point in the cotton economy of India. The period also coincided with the Industrial Revolution in Europe. Various measures were taken by the East India Co. from 1788 for the growing of more cotton, and during this period the area under cotton increased very considerably. Exports to Britain reached their peak during 1866, following the cotton famine resulting from the American Civil War. America was the only competitor with Indian cotton in the English market, and the competition at a later stage favoured American cotton, and by the end of the 19th century England ceased to be an important buyer of Indian cotton. This setback in the export of Indian cotton to Britain resulted in expansion of exports to other European countries, *viz.* France, Germany, Italy, Belgium and Russia. Japan came into the market as a purchaser by about 1890 and she gradually came to occupy the first place in the list of consumers of Indian cotton.

The first mill

The first cotton mill in India was established near Calcutta in 1818. But it was not until early in 1854, when Mr. Davar's mill

Plucking cotton

—the Bombay Spinning Mill—started at Tardeo near Bombay, that development was significant. An impressive industry has since grown up from these modest beginnings. Table 1 shows progress of the industry during 1876 to 1953.

TABLE 1

Year	*No. of mills*	*No. of spindles*	*No. of looms*
1876	47	1,100,112	9,139
1905	197	5,163,486	50,139
1953	457	11,721,139	207,250

The partition of India in 1947 resulted in the Indian Union having 408 mills compared to 421 in undivided India. Today, India has 457 mills in which the yarn produced on 11 million spindles is woven into cloth by 200,000 looms. The yarn output in 1953 was estimated as 1,513 million lb. and cloth output as 4,960 million yd.

With the growth of the Indian textile industry, the demand for raw cotton also increased proportionately. As a result of this, the average annual production of cotton in undivided India increased from 1,583,000 bales for the quinquennium ending 1882-1883 to 3,734,000 bales during the quinquennium ending 1906-7. During the same period, the average annual exports and mill consumption increased from 1,302,000 bales and 362,000 bales to 1,928,000 and 1,873,000 bales respectively. Today, the industry utilises practically the entire cotton crop of India, except about 200,000 bales of short staple cotton, in addition to foreign cotton at an estimated cost of Rs.100 crores.

Acreage under cotton

Acreage under cotton in 1923-24 was about 26,801,000 acres. By 1938-39, it had shrunk to 23,490,000 and to 14,901,000 by 1946-47 before partition—about 45% less than the acreage in the triennium ending 1938-39. For the reduction between 1938-39 and 1946-47, the ' Grow More Food ' campaign was largely responsible. There was large scale diversion of land from cotton cultivation to food production.

On partition of the country, from the 14,901,000 acres in 1946-47, 3,230,000 acres—about 22%—went to Pakistan. India was left with 11,671,000 acres only. The area under cotton in 1950 was estimated at 12,173,000 acres, in 1951 at 14,556,000 and in 1953 at 16,213,000 acres. The following figures of cotton cultivation in India state-wise will be of interest (Table 2).

TABLE 2

State	1941-42	1949-50	1950-51	1951-52
		(in million acres)		
Punjab	0.7	0.3	0.5	0.5
Pepsu	0.4	0.2	0.3	0.3
Uttar Pradesh	0.4	0.1	0.1	0.2
Madhya Pradesh	3.8	2.8	2.8	3.3
Hyderabad	3.3	2.2	2.4	3.1
Madras	2.5	1.7	1.7	1.8
All India	20.5	12.2	14.5	16.2

The entry of Japan into the war cut out the Japanese market for Multan cotton, and the difficulties of transport reduced exports to other countries also. India was therefore left with a large stock of short staple cotton. During this period, there was a move by the Government of India to grow more food and use the cotton lands to increase food production. This resulted in considerable reduction in the area under short staple cotton.

Increasing production

There is great scope for increasing the production of cotton in India, particularly of the long staple varieties. Considerable progress has been made in this direction and during the 1953-54 season India produced 1,365,000 bales of long staple cotton. With the increase in irrigated areas from the many projects under construction, the area under staple cotton in India is rapidly increasing.

Apart from the extension of the area under cultivation, the chief means available for increasing the production of cotton are: (1) The greater use of improved seed, (2) increasing the yield per acre. The area covered by improved varieties of cotton at present is slightly less than half the total area under cotton cultivation. If improved varieties are brought into the remaining area the additional production likely to be obtained may be considerable.

Increasing the yield per acre of cotton by manuring, extension of irrigation and agronomic practices are considered very seriously by the State Governments in their respective areas. The cotton-grower in India is not as yet fertiliser-minded and it would be necessary to demonstrate on an extensive scale the advantages of manuring cotton. As regards irrigation facilities, any appreciable extension of the area of irrigated cotton would not perhaps be possible until the major irrigation projects under construction are completed. By adoption of new agronomic measures, it is expected that a substantial increase in production can be attained. They are (*a*) bunding, (*b*) early and proper preparation of land in summer, (*c*) early sowing, (*d*) introducing groundnuts in rotation before cotton and (*e*) inter-cropping.

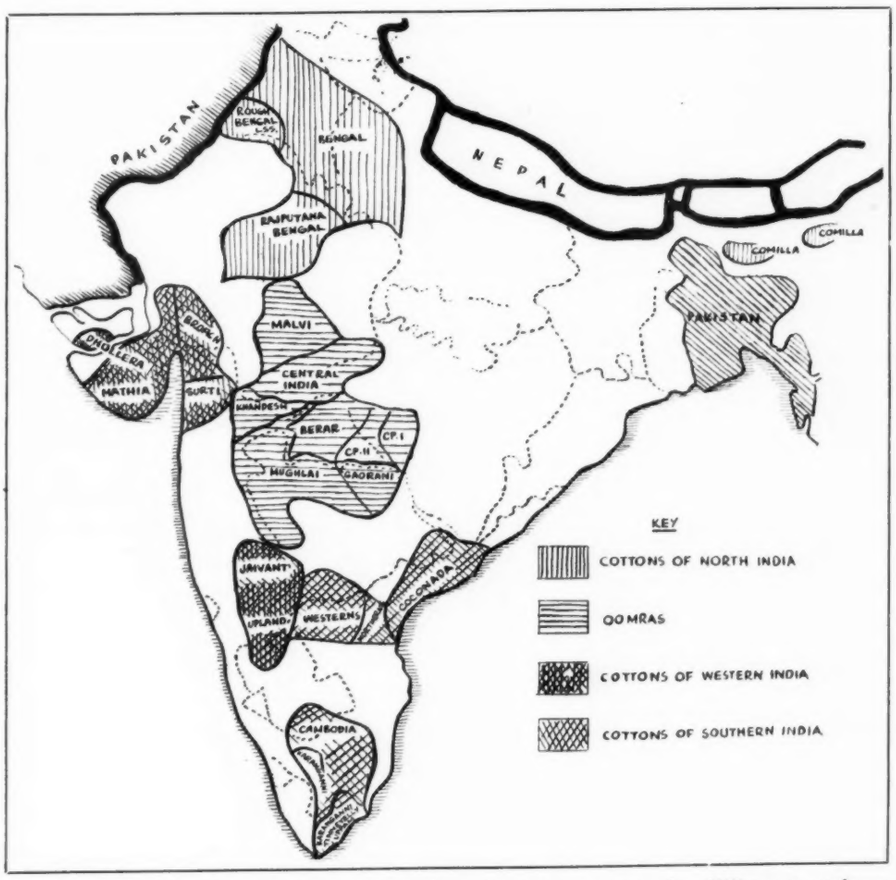
Experiments carried out in the State of Bombay and elsewhere have indicated that bunding can increase the yield of the cotton crop by about 5%. As regards early and proper preparation of land and early sowing, it may be mentioned that in the case of monsoon crops early sowing increases the yield by about 10% to 15%. It is estimated that the cumulative effect of adopting the agronomic measures mentioned in items (*a*) to (*d*) above would be to raise the yield by about 25%. The adoption of these improved agronomic practices is feasible on about four million acres in the States of Bombay, Madhya Pradesh, Hyderabad and Madras. This would give an additional production of about 2 lakhs bales.

An Indian village woman with her load of cotton

Mixed cropping of cotton with groundnuts is another measure which can advantageously be adopted to raise the production of cotton without affecting the production of food crops. Even the production of groundnuts will not be reduced to any appreciable extent if the inter-crop of cotton does not affect any large part of the oilseed crop. Experiments conducted in the State of Madras have shown that by sowing one or two rows of cotton after every 8 to 10 rows of groundnuts, an average cotton crop can be obtained in addition to the usual production of groundnuts. In the cotton-growing tracts of Madras, Madhya Pradesh, Bombay, Saurashtra and Hyderabad, such inter-cropping can be adopted over an area of about 15 lakhs acres. Cotton varieties suitable for cultivation in these tracts are already available. The additional yield of cotton that may be obtained by adopting inter-cropping on 15 lakhs acres of groundnuts may be estimated at about 50,000 bales.

Varieties of cotton in India

India, which enjoys the distinction of being the birthplace of cotton, grows at



Cotton map of India, showing varieties of cotton grown in different regions

present mostly short and medium stapled* cotton, the finer and long stapled varieties being mainly confined to Egypt and America. The several varieties grown in India can be grouped under two heads *viz.*: (1) the Asiatic and (2) the American.

The 'Asiatic varieties' are grown all over the country. They are hardy and thrive under the most varied conditions of climate and soil. The important types grown in India include Bengals, Americans, Oomras (Jarilla and Verum are the best known varieties in this group), Broach, Surti, Dholleras, etc. The bulk of the Indian cotton crop falls under the Asiatic varieties and the American type is grown largely in Madras and the Punjab.

Long staple cotton

Madras has earned the distinction of being the main home in India of quality cottons of the American types, of staple 1 in. and above; at the same time the output of cotton has been more than doubled on a slightly less area devoted to this crop. The annual additional income to the cotton cultivator has been computed at over Rs.4 crores a year—a striking tribute to the value of the patient and painstaking work of the cotton research workers of the Madras Agricultural Department in the matter of plant introduction, plant breeding and agronomy.

Two main trade varieties of cotton are grown in Madras, *viz.*: (1) the American type Cambodia, including Rajapalayam, (2) the indigenous type Karunnganni. Cambodia was introduced in Madras in 1908. The summer crop is popularly known as 'Rajapalayam' or Madras Uganda 1. It is grown under irrigation in South Arcot, Madura, Ramnad and Tinnevelly districts. 'Rajapalayam' is, in fact, the best among quality cottons raised in India and it has a staple length of 1 in. to 1 $\frac{1}{16}$ in. as against $\frac{15}{16}$ in. to 1 in. of the other types of irrigated Cambodia and $\frac{7}{8}$ in. in respect of the unirrigated crop. Apart from the higher yield, the quality of the irrigated Cambodia is superior to the unirrigated crop. With a view to maintaining the quality of Madras Uganda (Rajapalayam), the State Government has insisted on the registration of the areas sown and arrangements are in force for certification of the lint. The State Government has also enacted the Cotton Control Act which, when enforced, will help to maintain the purity and the reputation for quality for which Madras cottons are famous. The second important trade variety is Karunganni, which is raised on over 550,000 acres of black soils in areas of 25 in. to 30 in. rainfall in the districts of Tinnevelly, Madura, Ramnad and Coimbatore.

The Madras Agricultural Department has successfully launched two lines of development of cotton cultivation which may have a great bearing on the development of the textile industry in India. The first is the cultivation of Sea Island cotton in the West Coast region and the second is the utilisation of rice fallows in deltas growing American cotton. Sea Island cotton is the finest type of cotton in the world; it was first grown on the West Coast of India where conditions of rainfall, temperature and humidity are similar to those obtaining in the Sea Islands. It seems possible to raise a profitable crop of Sea Island cotton spinning to over 100 counts. The cultivation of cotton in the rice fallows was started with the aim of increasing cotton production without affecting production of paddy.

States other than Madras have shown themselves willing to extend cultivation of cotton without taking land away from food crops. Orissa, West Bengal and Assam have developed schemes for extension of cultivation. In Uttar Pradesh, there has been a rise from one lakh to two lakhs acres. Along with this, improved varieties have also been supplied. The increase in acreage has mainly occurred in Bombay, the Punjab, Hyderabad, Rajasthan and Saurashtra and has been generally attributed to favourable weather conditions at the sowing time.

Cotton position

With the partition of India in August 1947, the Indian Union was faced with the problem of making up the deficit of about 10 lakhs of bales of long and medium staple cotton which used to be obtained from the area transferred to Pakistan. The situation was met in 1947-48 and 1948-49 when the total mill consumption of cotton was 42.1 lakh and 42.5 lakh bales respectively, by continuing imports from Pakistan on a reduced scale. The position, however, became acute in 1949-50 owing to the cessation of imports of cotton from Pakistan as a result of the currency deadlock between India and Pakistan. Again

TABLE 3

Year Ending August 31	(1,000 *Bales of* 393 *lb. each*) Production				Mill Consumption			Exports
	Long Staple	*Medium Staple*	*Short Staple*	*Total*	*Indian*	*Foreign*	*Total*	
1950-51 ..	684	1,448	839	2,971	2,517	1,105	3,622	176
1951-52 ..	918	1,223	992	3,133	2,987	1,084	4,071	200
1952-53 ..	900	1,366	865	3,131	3,611	849	4,460	309
1953-54* ..	1,365	1,623	947	3,935	3,900	700	4,600	200

*Estimate

Cotton crop in an experimental area

* 'Staple' may best be defined as 'the average length of the bulk of the fibres of the cotton.' It is usually found by taking a tuft of cotton and after removing the short fibres by drawing the same between fingers and thumbs, measuring the average length of the fibres remaining.

A weekly fair in a cotton-growing district. The cultivators bring their cotton to market and the dealers pack it first into 100-lb. bags. These bags are then sewn into 300-lb. bundles and loaded on to oxen carts and taken to the mills or the railheads

the situation was met by stepping up imports of cotton from countries other than Pakistan from 7.4 lakhs bales in 1948-49 to 12.5 lakhs bales in 1949-50. On an average, India has had to import annually one million bales of foreign cotton at a heavy cost, not only to make good the short fall in domestic production but also to enable the industry to manufacture finer varieties of yarn and cloth. In order to make India self-sufficient in her cotton requirements, the Government of India sponsored a plan for increasing the production of cotton by extension of the area under cotton and by the application of ammonium sulphate to the cotton crop, by inter-cropping groundnuts and other crops with cotton and by expanding the area under improved varieties. Table 3 indicates the latest position in regard to cotton in India.

In recent years, exports of Indian cotton have considerably decreased and have varied from 180,000 to 300,000 bales. The main destinations are Japan, Europe, the United Kingdom and the U.S.A. The quantity of cotton permitted for export during 1953-54 was only about 175,000 bales and consisted almost entirely of short staple cotton.

The agricultural section of the Five-Year Plan sponsored by the Government of India envisages the production of 4,229 thousand bales of cotton in 1955-56. This is by no means an overestimate since, with the completion of the river valley projects better irrigation facilities will be available in many of the cotton growing areas. Owing to the excellent monsoon and the increase in acreage, the commercial crop in 1953-54 is expected to be about 40 lakh bales. Efforts made since partition to increase the growth of long staple cotton have largely succeeded. With the present level of production, the estimated annual consumption of Indian cotton is about 36 lakh bales and the crop estimates for the past season and for the coming season are expected to leave a good carry-over for the following season.

Indian Central Cotton Committee

It was not until the Indian Central Cotton Committee was established in 1923 that cotton improvement work started in earnest in India. The aim of the committee was to supplement the work of the agricultural departments of various states by providing funds for research into agricultural as well as technological cotton problems and the development and marketing of improved varieties of cotton. The committee has so far financed about 150 to 160 schemes, a large number of which were for breeding high yielding superior types, some for the study and control of the important cotton pests and diseases, a few for physiological studies of the crop growth and a good number for the extension and marketing of improved varieties of cotton. The funds expended so far on these schemes amount to about Rs.2 crores, derived either from the cotton cess or from grants made to the committee by the Government of India.

The research on cotton pests and the physiological investigations on the cotton plant sponsored by the committee have saved cotton growers from losses running into crores of rupees. Particular mention may be made of the efforts to control bollworms, stem weevil, cotton wilt and Tirak disease (defective boll opening). The annual saving to growers in Madhya Pradesh, Bombay and Karnatak alone by the introduction of wilt resistant varieties is estimated to be about Rs.68 lakhs. Much technological research has been conducted on crop improvement in the well-equipped technological laboratory in Bombay of the Indian Central Cotton Committee. This laboratory also carries out and publishes the results of spinning tests on Indian cottons.

Cotton policy

To stimulate interest in cotton growing, the Government of India in 1950 removed all legislative and executive restrictions on the growing of cotton; provided, wherever possible, additional irrigation facilities; remitted land revenue in respect of additional lands brought under cultivation; gave guarantees to State Governments to make good the short fall in food grains caused by the diversion of land from food crops to cotton; made available subsidised supplies of improved seed and fertilisers and lent State Governments funds required for their bulk purchase; appointed in all cotton growing States special staff to supervise the execution of the plan for increased and improved production and increased the basic selling prices of all varieties of cotton by Rs.150 per candy (784 lb. of lint) in comparison with the controlled prices fixed for them in the previous year.

The Government of India has decided to continue the policy of control over cotton during the next season—September 1954 to August 1955. Floor and ceiling prices for various types of cotton will continue to be laid down as before, but the Government has decided to lower the floor price by Rs.55 per candy. The Government has also decided not to allow any further exports of Bengal deshi cotton during the current season. By lowering the floor price by Rs.55 per candy, it has reverted to the position as it was before July 1952. The floor for the basic variety—Jarilla of 25/32 in. staple length—will accordingly be Rs.495 per candy. Floor prices of other varieties of cotton will also be correspondingly reduced. Ceiling prices will, however, continue unchanged.

The system of allocating quotas of Indian

cotton supplies to mills will also be continued during the next season, but as many mills have exhausted the quota of cotton allocated to them from the 1953-54 crop it has been decided to allocate to them immediately 25% of the normal quota. Deliveries will be effected on or after September 1, 1954. Hitherto, for the purpose of such allocations, the country has been divided into two zones—the northern and southern zones—and quotas of cotton given to mills from each zone separately. It has now been decided that this zonal system shall be abolished and mills allowed to purchase their cotton quota from any area they like.

Photos: Press Information Bureau, Government of India.

Raw cotton being reeled in machines for transfer to the spinning section in a cotton mill

The Jubilee Conference of the Association of Applied Biologists

The Association of Applied Biologists, founded in the year 1904, celebrated the golden jubilee of its foundation by organising a conference on September 13 to 17, 1954.

The conference was held under the presidentship of Prof. W. Brown, M.A., D.Sc., F.R.S., Emeritus Professor of Botany in the University of London, and a considerable number of prominent biologists from Britain and various overseas countries attended. The programme of symposia and lectures covered the majority of the subjects with which the association is concerned and in the course of them the past achievements and many of the future trends and developments of biological science were discussed.

In connection with the conference, a number of excursions and visits to research institutes and experiment stations in Britain were arranged to take place after the formal meetings.

The ordinary meetings of the conference were divided into two sections: the full meetings were held in the Jehangir Hall of the Imperial Institute, while the sectional meetings took place in the chemistry and physics lecture theatres of the Royal College of Science.

The opening meeting

At the opening meeting, the President of the conference, Prof. W. Brown, welcomed the delegates and declared the conference open. Replies on behalf of visitors from Europe were made by Dr. E. Gram, Director of the State Plant Pathology Institute of Denmark, and by Dr. K. Starr Chester, Director of the Batelle Memorial Institute, on behalf of visitors from America.

Subsequently, Sir E. John Russell, F.R.S., delivered the opening address, taking as his subject ' The Changing Problems of Applied Biology.' In the course of his address Sir John traced, with his accustomed skill, the course of the development of biological science in its application to agriculture in the 50 years which have elapsed since the foundation of the association, outlining some of the achievements and paying tribute to many distinguished workers in this field.

The sectional meetings

The sectional meetings were as remarkable for the variety and range of the subjects covered as for the importance of some of the discourses. The subjects included international co-operation in the field of crop protection, insect pests of stored products, plant viruses, plant growth regulating substances, problems in applied zoology, soil-borne pests and diseases, education in applied biology, crop protection, forecasting and assessment of plant diseases, and plant nematodes.

Of the numerous papers which appeared under these diverse heads, it may perhaps be permissible to mention that by Prof. R. L. Wain, of Wye College, on ' A New Approach to Selective Weed Control,' in which he outlined recent work in his department which throws new light on the selective action of aryl oxy weedkillers, and which may have practical application, and Prof. Hubert Martin's remarkable discourse on ' Some Basic Problems in the Application of Chemistry to Crop Protection.'

Addresses to plenary meetings

In addition, addresses were given before meetings of the full conference by Prof. Stakman, of the University of Minnesota, on ' Progress and Problems in Plant Pathology,' by Prof. V. B. Wigglesworth, F.R.S., on ' The Contribution of Fundamental Research to Applied Biology,' and by Dr. K. W. Neatby, of the Canadian Department of Agriculture, on ' The Application of Biological Research to Canadian Agriculture and Forestry.'

On the evening of September 13, a conversazione was held in connection with the conference, in the chemistry laboratories of the Royal College of Science, at which a large number of exhibits were displayed illustrating various aspects of the control of pests, diseases and weeds. The exhibits attracted much attention. For the general organisation of the conversazione Dr. W. F. Jepson, O.B.E., Reader in Entomology at the Imperial College of Science, was responsible.

On all counts it must be agreed that the conference proved a notable success.

Official Control of Husbandry in Great Britain

R. B. WHALEY

All over the world the events of the past fifteen years have shown that to safeguard the most important heritage of a nation, its cultivable lands, to ensure their efficient use and to guard against their wasteful exploitation, a far greater measure of government control may be required than had previously been regarded as desirable and necessary. In the United Kingdom there developed during the war years a system of drastic control over husbandry, which has been maintained albeit in modified form since then. The following article describes and discusses these controls; it will be read with interest since it gives an indication of lines which might be followed elsewhere, and especially as the operation of the existing controls has given rise to much criticism in regard to a recent case which has attracted wide attention.

PRIOR to the First World War governmental controls over farming in England and Wales were limited, and those existing were confined to matters of notification of infectious diseases in livestock, regulations for periodical dipping of sheep, etc. Emergency regulations were put into force, but these were not particularly stringent and were dropped soon after the termination of the war.

During the Second World War drastic controls were applied to agriculture by defence regulations and under these directions could be given to any occupier as to the manner in which he farmed, and the crops he grew, and dispossession could follow without any right of representation or appeal by the person concerned.

Following the war it appeared desirable to put agriculture on a firmer basis than had obtained in the past and, with this object in view and to replace the defence regulations, the Agricultural Act, 1947, and the consolidating Agricultural Holdings Act, 1948, were introduced. These Acts set out to stabilise agriculture by giving the farmer security by guaranteed prices over a period, by giving a greater security of tenure to the tenant farmer, and by giving grant aid towards the cost of the reclamation of derelict and marginal land.

In return for this help the Government required that every occupier should farm his holding up to a reasonable standard of husbandry, and also required from the landowner the same standard in the management of his side of the farming enterprise.

Control of husbandry

The Agricultural Act of 1947 lays on the Minister the responsibility of ensuring a reasonable standard of efficient farming, and defines the rules of good husbandry. These shortly are:

That the occupier should maintain a reasonable standard of efficient production both as regards the quality and quantity of the crop and stock produced, and that the land should be kept in a condition to maintain efficient production.

To carry out the administration of the Act the Minister has delegated powers to county agricultural executive committees. These committees have been set up in most counties and are each composed of 12 members, seven appointed by the Minister on the nomination of the National Farmers' Union (3), the Country Landowners' Association (2), and the Agricultural Workers' Union (2). The remaining five, including the chairman, are appointed directly by the Minister.

The main committee is assisted by subcommittees and, in addition, there are a number of district committees composed of local farmers.

Procedure

When a case of bad farming comes to light, the committee endeavours to persuade the farmer to improve his methods and technical advice is given. When all efforts of persuasion fail, action is commenced to put the occupier's farming under supervision. Before doing so the committee must allow him to come before it and make representations if he so desires. Having served a supervision order, it is empowered to serve directions to remedy defects and/or carry out improvements in the farming. Up to the last year or so the general procedure was for the committee to issue specific directions with

Old granary and barn range

regard to the cultivation, manuring and cropping of each field on the holding, on which the farmer's management was below a reasonable standard. This was followed by fortnightly visits from the district officer, who would advise on the day-to-day management. This procedure has been dropped, because it was found that in effect the committee was farming the holding, and there was no way of ascertaining whether the occupier was himself showing any improvement.

The present procedure is to serve a general direction detailing in what way the farmer is failing to farm his land properly, and indicating from whom advice is available for the asking.

The annual review

At the end of the first year of supervision the committee holds an annual review of the supervision order. Where there has been a satisfactory improvement in the farming of the holding over the year, and the committee feels that the occupier has benefited from the advice and may well be left to manage for the future on his own, then the supervision order may be revoked.

Where there is still a doubt as to the occupier's having reached a reasonable standard of farming, then the supervision order continues and the matter is again reviewed at the end of the second year or earlier if warranted. If at the first annual review it appears to the committee that there has been no satisfactory improvement, then action may be started to dispossess the occupier.

Dispossession

Before action is taken the farmer is again invited to make representations to the committee, either verbally or in writing. On making verbal representations, either at this stage or when making representations against the proposed supervision order or direction, he may be accompanied by his solicitor, land agent, or any other person to speak on his behalf. If, after hearing representations, the committee decide that dispossession action should be pursued, and the Ministry concurs, a notice of the Minister's proposal to dispossess is served on the occupier, and he is also notified that he may appeal to the Agricultural Land Tribunal against the Minister's proposal.

If the tribunal dismisses the occupier's appeal, an order is served terminating his interest, as occupier, in the land at a date not less than three months after the order. If the occupier is a tenant, the landlord must either farm the land himself or let it to a tenant approved by the committee.

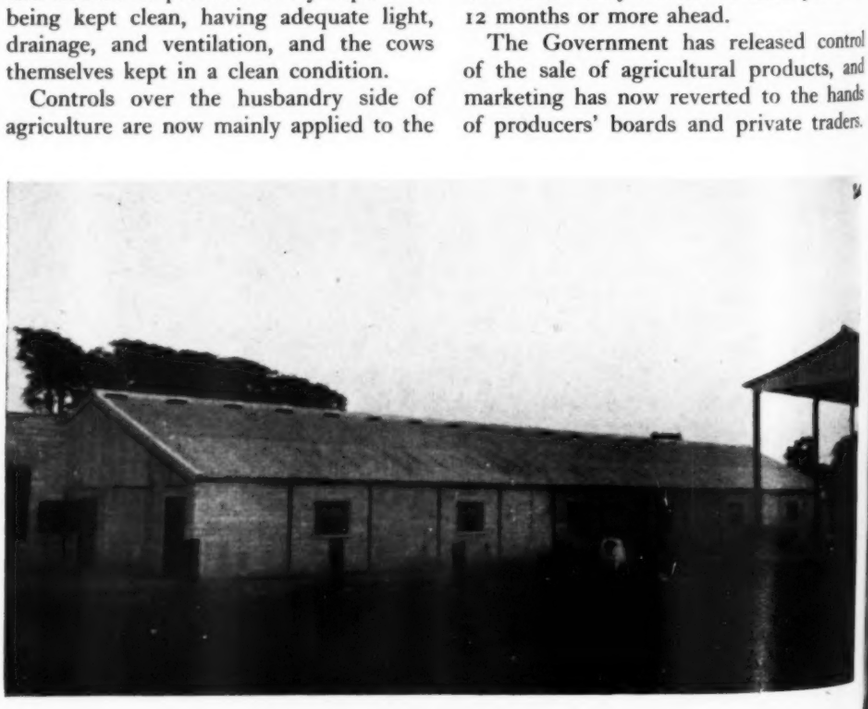
High-level moorland infested with bracken and scrub, of little grazing value

An owner-occupier dispossessed on husbandry grounds alone must let the land to an approved tenant, but retains his interest as owner.

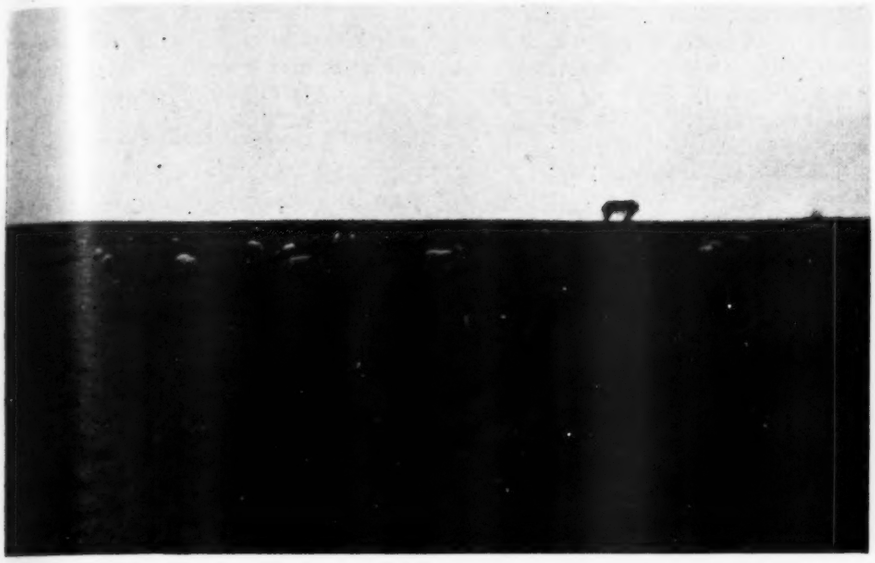
Apart from the provisions of the Agricultural Act, probably the most important controls are those arising from the milk regulations under the Food and Drugs Act. These lay down that all premises in which cows are milked, the milk being for sale for human consumption, must be up to certain standards. Broadly these standards are that the cows should be milked and housed in premises easily capable of being kept clean, having adequate light, drainage, and ventilation, and the cows themselves kept in a clean condition.

Controls over the husbandry side of agriculture are now mainly applied to the individual's farming of his holding. Most of the controls under the defence regulations, whereby each farmer could be directed to grow particular kinds of crop at any particular time, are not at present in force. Control over the individual farmer's standard of husbandry was taken over by the Government, against a pledge to provide guaranteed prices for all the main items of agricultural production. The prices are fixed after negotiations with the National Farmers' Union at the price review in March of each year, and each commodity receives a fixed price for 12 months or more ahead.

The Government has released control of the sale of agricultural products, and marketing has now reverted to the hands of producers' boards and private traders.



Modern piggery with Dutch barn



The same land carrying a good ley after reclamation, Pioneer cropland reseeding at a cost of £45 per acre, half the cost being met by the State

To meet a possible call to implement the guaranteed price, different procedures have been devised for various products, but generally, it is to be done by deficiency payments.

Financial aid to farmers

Financial assistance is also given to farmers by subsidies, and grants in respect of certain commodities and improvements on poorer types of land. Grant aid is available up to 50% of the cost of the work on all land for the application of lime, installation of water supplies, drainage and ditching. On the poorer marginal land these grants are available for reclamation, re-seeding, fertilisers, fencing, etc., and in some upland areas the grants extend to the provision of all items of fixed equipment, including dwelling houses.

Control of estate management

Tenant farmers had to some extent become accustomed to the control of their husbandry during the war, but the control now exercised by the Minister over the management by the owner is something new. Under the Act responsibility is placed on the Minister to ensure good estate management on all agricultural holdings. By good estate management is meant that the owner must provide and keep, subject to the terms of the tenancy agreement, and the repair and maintenance regulations, all the fixed equipment on the holding up to a standard that will allow an occupier to maintain efficient production.

Where cases come to light of unsatisfactory conditions of the equipment, the owner is visited by the committee land agent, with a member of the estate management sub-committee, who endeavour to persuade the owner to carry out his obligations. To a great extent owners are co-operative, and more improvements are obtained by persuasion and advice than by direct action by the committee. Occasions arise, however, where the owner is either unwilling, or unable financially to co-operate and then, if conditions of the fixed equipment on the estate are bad, supervision is considered by the committee.

The same procedure is followed as in husbandry cases. The owner is invited to make representations before the committee and, if it is ultimately decided to place the management of his lands under supervision, directions are given to enable the owner to know what is expected of him.

Estate management problems are on a longer term basis than those of husbandry as the remedying of unsatisfactory conditions cannot be expected to make much headway in the course of 12 months. An annual review, however, must be carried out each year, and if the owner is making an effort to co-operate and meet his obligations, it is reasonable for the supervision order to run on much longer than would be the case under a husbandry order.

Probably the most difficult cases the committees have to deal with are those of single owners of small farms, who have little or no capital available, and where buildings have suffered from long years of neglect. Here the best solution is to persuade landlord and tenant to co-operate in doing the required work, but all too often these cases bring to light the uncooperative landlord and the belligerent tenant.

If the owner makes no effort to comply with the directions, dispossession action would generally be taken after the first annual review, if it appeared he was not making satisfactory improvement. If, after hearing representations, the committee decides to recommend dispossession, and the Ministry concurs, the owner is served with a notice of proposal to dispossess, which involves ' issuing a certificate that the Minister considers that there has not been satisfactory improvement during the period of supervision.' The owner has the right of appeal to the Agricultural Land Tribunal against this, but if he does not appeal, or if the tribunal dismisses the appeal, the certificate takes effect as a compulsory purchase order.

The owner must then sell the holding to the Minister at its market price, which is generally agreed after negotiation between the Minister's land commissioners and the owner's valuers.

Security of tenure

Apart from these controls, the landlord is affected to a great extent by the provisions of the Acts in regard to security of tenure given to tenants. The provisions have cut right through an owner's right to dispose of his property as he thinks fit, a right which he and his predecessors have exercised since times immemorial. In effect, the provisions mean that once a landlord lets a holding to a tenant it is only in unusual circumstances that he is able to regain possession of his land while the tenant is alive and is farming it in a satisfactory manner.

No direct benefits are given to landlords to set off the obligations placed on them, but the landlord is given certain allowances under the Finance Acts in respect of income tax and death duties.

It may appear that the benefits to a landowner are limited in contrast to the obligations imposed on him under the Acts, and the interference with his power to dispose of his own land, and this as regards an individual owner is probably true. On the other hand, the Acts are designed to give stability to agriculture and to allow a fair standard of prosperity on a long-term basis, and if this state of affairs comes to fruition it follows that landlords will benefit, in that their rents are more secure and they can with confidence expend capital on improvements to their land.

Landlord and tenant

The landlord and tenant system still exists in England and Wales, despite the break-up of many large estates following two world wars and the incidence of high death duties.

The 1948 Act deals with matters arising between landlord and tenant. Prior to the passing of these Acts and defence regulations, a landlord was able to give 12 months' notice to a tenant and, apart from being entitled to compensation for disturbance, a tenant had no remedy and would have to quit.

Under the new provisions a tenant, on receiving a notice to quit, is entitled to serve a counter notice on the landlord requiring him to obtain the Minister's consent before the notice can become operative. The landlord must then make application to the committee for the Minister's consent.

The grounds under which a landlord may succeed are laid down in the 1948 Act, and in all five separate grounds are provided. Generally, the grounds open to a landlord in a normal case are limited to two: those under Sections 25 (1) (*a*) and 1 (*d*) of the Act. Under 25 (1) (*a*) the landlord must satisfy the Minister that the purpose for which he requires the land is in the interests of efficient farming, either in respect of good husbandry or good estate management.

Under good husbandry, it is usually a matter of comparison between the farming carried on by the tenant and the farming as it would be if the landlord resumed possession. Under good estate management, the landlord has to prove that the land would be more economically managed if it was added to other land in his possession, or that it could be more economically equipped with a house or buildings, or possibly that, by reason of its situation, it would be more advantageously farmed if attached to another unit.

The second ground on which an application for the Minister's consent can succeed is that of greater hardship on the landlord if consent is refused than on the tenant if consent is given. An application under 25 (1) (*d*) is only open to a landlord who was the landlord on or before August 6, 1947, and where the tenancy existed at that date. The landlord must prove that withholding consent would cause greater hardship on him than would fall on the tenant if he had to vacate.

The Minister must refuse consent, however, unless he is satisfied under one or other of the grounds provided, and, even if satisfied, he can exercise discretion in favour of the tenant.

The landlord may succeed in satisfying the Minister in regard to more efficient farming, but the Minister may consider that the hardship likely to fall on the tenant, if he has to vacate, outweighs the benefits of increased production that would follow the landlord obtaining occupation and exercise his discretion in favour of the tenant and refuse the application. Following the Minister's decision the unsuccessful party has the right of appeal to the Agricultural Land Tribunal.

Compensation to tenants

Other matters dealt with in the 1948 Act include provisions with regard to compensation due to the tenant on the termination of a tenancy. The tenant is entitled to compensation for disturbance if he leaves on a notice to quit served by the landlord. This normally is equal to one year's rent. The tenant is also entitled to compensation for the value of crops grown and unconsumed, tillages and seeds sown, etc., together with unexhausted manurial values of fertilisers applied and feeding stuffs fed to stock, etc.

Prior to the 1948 Act compensation for tenant right was valued under what was referred to as ' Custom.' This meant that over the country the basis of valuation for compensation varied under local custom, and there was no uniformity with regard to the amount of compensation to which a tenant was entitled. The Acts abolished ' Custom ' by laying down the type of improvements for which a tenant is entitled to compensation and the basis on which they should be valued.

Other provisions

Provisions are also made whereby either the landlord or the tenant may require the terms of the tenancy to be reduced to writing, and if the parties cannot agree then either party may demand that the matter be referred to an arbitrator. Similarly, either party may demand that the amount of rent be referred to arbitration.

Regulations are made which lay the responsibility for the repair and maintenance of fixed equipment on the landlord and the tenant respectively, but only in so far as the responsibility is not expressed in a written tenancy agreement.

It is worthy of note that under the Acts the occupier is given freedom of cropping, despite any contrary clause in a tenancy agreement, providing he returns to the land the equivalent manurial value of the crop he takes off.

The only restrictions against a tenant's cropping are that he must abide by the terms of his tenancy agreement during the last year of his tenancy. He is not entitled to plough up the landlord's pasture without the consent of the landlord or the committee, and he is not entitled to remove from the holding any farmyard manure produced thereon. If a tenant carries out a system of farming which over the years deteriorates the holding, the landlord would have a remedy either by an action for damages on a breach of the tenancy agreement during the lease or compensation for dilapidations on termination.

Agricultural land tribunals

Mention has previously been made of matters arising under the Agricultural Acts, which can be referred as an appeal to the Agricultural Land Tribunal. The setting up of these tribunals under the Acts is an outstanding difference between the procedure under the defence regulations and that provided under the Acts.

Under the defence regulations, the Minister was empowered to take the most drastic actions against farming occupiers without the person concerned having the right of any representations to the Minister or to an independent court or tribunal. Now appeal can be made against all proposals by the Minister to take drastic action, either against the owner or the occupier, as well as the appeals against the Minister's decision in notices to quit and certificate of bad husbandry cases.

Each tribunal comprises a legal chairman, a landowner and a farmer, who are independent of the Minister.

The effect of controls

What is the effect of this governmental control over husbandry? During the period under review agriculture has enjoyed reasonable stability and the standard of husbandry and production has risen enormously; but much of this must be attributed to the incentive of a high level of commodity prices and to the benefits of mechanisation and increased scientific knowledge.

It is fair to say, however, that responsible agricultural opinion welcomes controls and views with apprehension any suggestion of their removal, especially that of guaranteed prices; it feels, however, that the testing time may still have to come if world commodity production ever again exceeds demand or trade depressions occur.

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Cobalt Deficiency in Pastures and the Cause of Pining

DAVID LE ROI, M.A., B.Sc.

The liability of sheep and other ruminants to contract a morbid condition termed 'pining' when grazed on certain lands has long been known the world over. It has now been established that this is due to cobalt deficiency in the soil, and the condition can be cured by the administration of cobalt either as dressings to the soil or by administration to the affected animals.

EVERY animal body contains a varied assortment of mineral components in larger or smaller amounts and sometimes only in the merest traces. These include potassium, phosphorus, sodium, calcium, magnesium, silicon, chlorine, fluorine, iron, iodine, copper, manganese, aluminium, zinc, boron and cobalt. All these are as essential to life as are the energy-furnishing organic foodstuffs and, directly or indirectly, they stimulate and control most of those vital bodily processes which make all the difference between healthy and unhealthy stock.

These minerals must be present in the animal blood and tissue in correct amount and balance and can be supplied only by proper feeding. Serious mineral deficiency is invariably due to defects in feeding and, although this often can be rectified by giving the animals cakes and licks to provide the balance of minerals needed, it is generally more efficient to treat pastures and grow fodder crops so that they will supply the necessary minerals.

Cobalt deficiency

Cobalt, a mineral required only in the merest traces, is, curiously enough, one of the most essential to certain animals. Without cobalt, sheep and, to a lesser extent, cattle become unthrifty, lose their appetite, become thin and weak and may even die.

Throughout the world there are areas of seemingly rich pasture where sheep and cattle fail to thrive. The pasture may be plentiful and nutritious for most animals, but nevertheless sheep, and sometimes cattle, put to graze on it lose condition and eventually starve in the midst of plenty.

Pining

This mysterious condition has for long been recognised as being induced by some deficiency in feeding and its world-wide incidence has been called by various local names. In Britain, it is known as 'pine;' in Australia, as coast disease or enzootic marasmus; in New Zealand, as Morton Mains disease, bush sickness or Mairoa dopiness; in Kenya, as nakuruites; in South Africa, as lamsietke; in the Mid-West of the U.S.A., as neck-ail or grand traverse; and in Florida, as salt sick. In other parts of the world, it is called variously saut, blood rot, daising, vincus, vinkish, vinquish and vanquish.

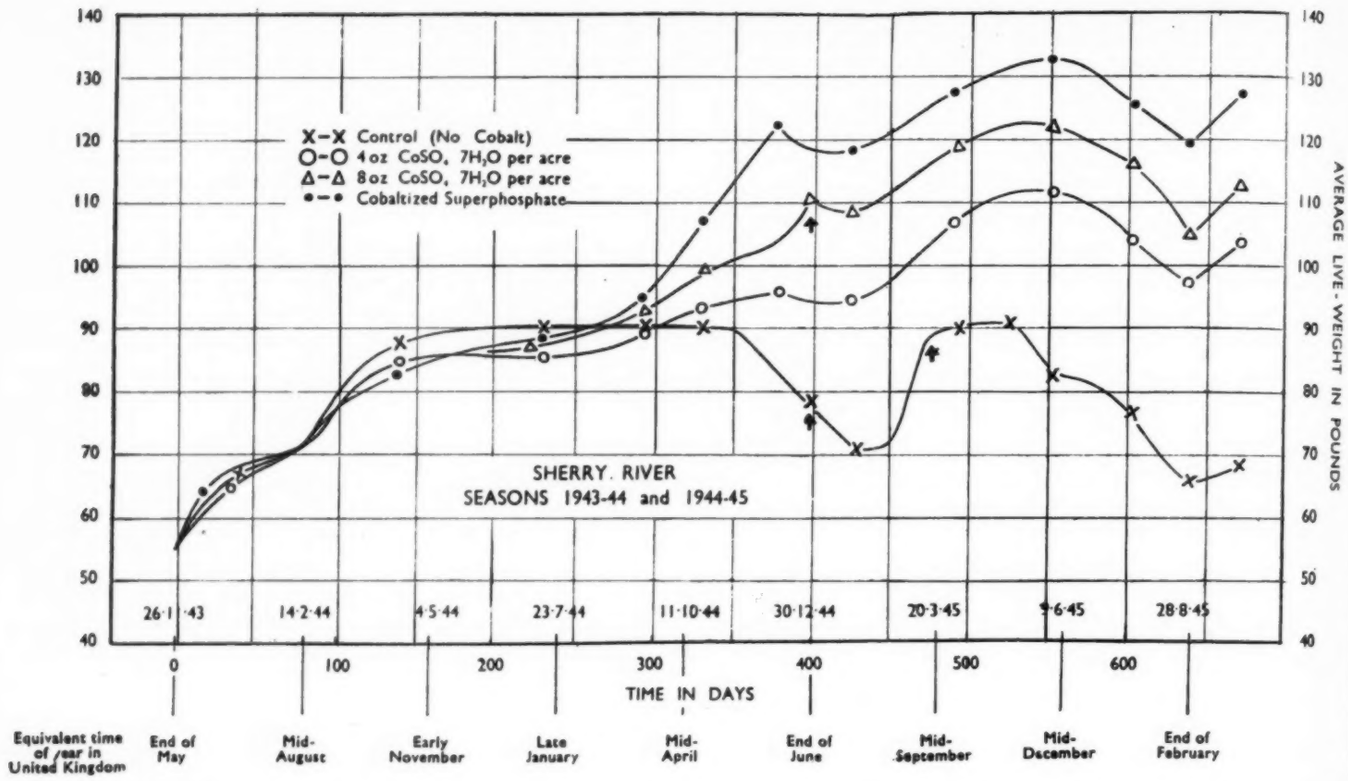
Pastoralists learnt from experience that in certain localities sheep and young cattle simply would not thrive because of this mysterious wasting disease. Often the affected areas were quite narrowly circumscribed, as when stock would thrive on one field and starve on an adjacent one. Thus for hundreds of years the existence of 'pining' fields or tracts of pasture have been noticed on certain individual farms in Scotland.

Control by stock transference

The general practice was to attempt control of the disease immediately it appeared by transferring stock to sound pasture. The method was to a considerable extent successful, but it was very wasteful of stock, pasture, time and labour, and, in any event, it did not get rid of the risk of the disease breaking out. At best, it resulted in unprofitable farming in many areas and at worst it led to the complete abandonment of farms. In countries such as Australia, New Zealand and America, where flocks and herds graze in hundreds of thousands on unfenced pastures, the removal of stock to sound land was a major undertaking and often difficult to arrange.

Pining, to give this fatally emaciating disease its most common name, is peculiar to ruminants and is therefore unknown in

The sheep on the left shows the result of cobalt deficiency



Average weights of sheep on plots in the Sherry River Valley area, showing effect of various treatments (*from N.Z. Journal of Science and Technology* (*Agricultural Section*), *June* 1946)

horses or pigs. On certain pastures in South Australia, for example, where ruminants have been unable to survive because of wasting, marsupials abound, horses thrive and rabbits flourish to plague proportions.

Incidence and symptoms of pining

In its action, pining is more delayed with cattle than with sheep. The danger period with sheep is the three or four months following weaning, which in the farming year in Britain is from August to November. Sheep put on pining pastures start to 'go back,' as shepherds say; they lose vitality and do not put on weight. Pining sheep in a driven flock quickly lag behind their healthy fellows and eventually take to the ground. The fleece becomes dry and wiry, the eyes water and the ears droop. The stricken animal develops a forward stoop, the face becomes grey and in the final stage there is extreme emaciation with all the symptoms of acute anaemia.

There are no characteristic post-mortem appearances in animals that have died from pining. The post-mortem conditions of the carcase are simply those of an animal that has starved to death, but an animal that has starved in the midst of apparent plenty.

Strangely enough, although pining has been for centuries a recognised affliction of flocks and herds, it was only during the past 50 years that veterinarians and agricultural scientists gave much attention to the disease. And it is only much more recently that the clue to solve the problem was found.

Iron deficiency?

Because of the pale appearance of the gums, skin and eyelids characteristic of pining sheep, early research workers into the cause of the disease inclined to the view that it was a severe form of anaemia induced by iron deficiency in the diet. But the administration of certain soluble iron salts, such as ferric ammonium citrate, to affected animals did little to prevent the onset of the disease or to cure those already suffering from it. Moreover, detailed examination of the blood from pining sheep yielded no evidence of a true anaemia.

Despite the fact that numerous experiments had failed to prove that pining is an anaemic condition induced by lack of iron in the diet, most veterinarians were unconvinced and continued treating affected sheep with iron compounds. It was fortunate they did so, otherwise the real cause of pining and the ultimate method of preventing the incidence of the disease would not have been discovered.

Work in Australia

During the early 1930s, a team of research workers in Australia began treating pining sheep with heavy doses of iron compounds, but soon found that there was little relation between the iron content of the doses and their curative values. Some months later, affected animals were treated with an extract of limonite, which contains only a negligible quantity of iron. To everybody's surprise, the diseased sheep showed immediate improvement and it was then discovered that the curative element was in that fraction of the limonite extract containing manganese, nickel, zinc and cobalt.

It was then realised that the cure for pining must be in one of the four non-iron elements in limonite. Research workers in Australia and New Zealand began a series of experiments to establish which element was the curative agent and by a process of elimination rightly concluded that the essential element was cobalt.

Cobalt deficiency established as the cause

At that time, Western Australia was one of the worst affected areas and in that State of the Commonwealth special efforts were made to establish just how much cobalt was necessary to cure pining. It

was eventually found that affected sheep were cured by a daily dose of 0.1 mg. of cobalt, while 1.0 mg. of the element daily cured affected cattle.

Having established that cobalt cured pining, the next step was to find out if the element would prevent the disease. For that purpose the soil and grass of pasture land on which sheep developed pining was chemically analysed. In every instance, it was found that the pasture registered a cobalt deficiency compared with grassland on which sheep thrived.

Methods of control

There are three methods of ensuring that sheep and cattle receive the amount of cobalt necessary to cure or prevent pining: (1) individual dosing or drenching; (2) salt licks and mineral supplements; and (3) pasture dressing. Whatever method is used, the remarkable fact is the small amount of cobalt required. Obviously the easiest way to make good a cobalt deficiency is to top-dress the pasture.

Top-dressing

Experiments proved that the best results from top-dressing were yielded when the cobalt was applied in the form of chloride, but that the actual quantity varied according to the ground's natural deficiency. On average, however, 10 lb. of cobalt chloride, which contains 7.93 oz. of cobalt, was sufficient to treat 1 acre of pasture.

Chloride of cobalt can be combined with other manures, such as superphosphate or lime but the latter should not be mixed with cobalt sulphate. Either cobalt chloride or cobalt sulphate may be mixed with sand and then applied as a top-dressing. Whatever the medium used for applying the cobalt, the dressing should be scattered evenly over the pasture and left for two or three days before stock is allowed to graze on it.

Once it has been treated a cobalted pasture can be left for three years before redressing is necessary. At that rate, the average cost of maintaining the correct cobalt content of a pasture is approximately 3s. 6d. per acre per year. On the average farm in Britain 3s. 6d. per acre per year is not an excessive expenditure, but in Australia, New Zealand and South Africa, where the sheep stations measure their pastures in thousands of acres, the cost of regular cobalt dressing can be a serious item economically. Accordingly, the practice has arisen in the Dominions of setting aside areas of pasture which are fenced and then cobalt dressed. These runs are, in effect, hospital fields and stock is removed to them for grazing at the first sign of cobalt deficiency.

Salt lick

Salt licks containing the requisite mineral supplement have been widely and successfully used to repair cobalt deficiency and there are a number of proprietary licks containing the necessary amounts of cobalt. Because of their extreme ease of administration, licks are particularly suitable for use in dry climates, but they have the disadvantage that it is impossible to ensure individual animals receiving the correct dosage. Sheep vary considerably in their individual taste for salt, so that some will receive too much cobalt, some too little and others none at all. Where practicable, it is best to administer the licks by trough feeding and once the animals have been taught to take their ration of cobalt in this way they will continue to do so automatically.

Drenching

By far the most efficient method of administering cobalt is by dosing individual animals by mouth, as affected animals are thereby sure of receiving the correct dose. The drenching or dosing may be done daily or weekly with a stock solution in the proportion of 1 oz. of cobalt chloride crystals dissolved in 1 pt. of clean, cold water. The mixture keeps well in store if contained in a glass bottle fitted with a glass or cork stopper.

For daily drenching, take 1 fl. oz. of the solution and dilute it with 2 pt. of clean water; 1 fl. oz. of the diluted solution is then added to $\frac{3}{4}$ pt. of water. Each animal is drenched daily with 2 fl. oz. of the final solution. For weekly drenching, 1 fl. oz. of the stock solution is made up to $4\frac{1}{2}$ pt. with clean water and each animal drenched weekly with 2 fl. oz. of the diluted solution until completely recovered.

Because of the labour and difficulty of gathering stock for individual daily or weekly dosing, drenching is impracticable as a preventive of pining, except in the case of small flocks. It may, however, be necessary and practicable, where a few sheep in a flock have developed pining and must be cured. But it is always better to prevent than to cure and the most practical way to prevent pining is to administer cobalt to the sheep or cattle by top-dressing the pastures with cobalt.

Mode of action of cobalt

It is now accepted that cobalt deficiency induces pining and that repairing that deficiency by administering the element cures the disease. But the manner whereby cobalt prevents or cures pining has not as yet been established. Indeed, there are no definite factors yet established as to the physiological function of cobalt in the animal body. For a time it was thought that the main requirement of sheep for cobalt was because the element encouraged the growth of bacteria in their rumens that contribute to digestion. But research work in Australia has emphatically disproved that a sheep's ability to digest its food is in any way affected by cobalt deficiency.

Another theory suggested that cobalt in some way replaced the energy expended during a sheep's period of growth. It has been pointed out that, whereas a calf takes between two and three months to double its weight, a sheep does so in a fortnight; therefore a sheep must use more energy in its first few days of life than does a calf. But that hypothesis does not explain why a healthy adult sheep should develop pining when put to graze on pining pasture. So the mystery of pining remains, although the problem of curing it has been solved.

Sulphuric Acid Unit

The latest addition to Shell's Stanlow oil refinery, England, a plant capable of making 33,000 tons of sulphuric acid a year, and costing £200,000 to erect, began operation recently. With this plant and the two-year-old sulphur recovery plant, Stanlow becomes the only refinery in the United Kingdom which is entirely self-sufficient for supplies of sulphur and sulphuric acid. All the acid produced will be used in the refinery for treating and improving lubricating and white oils and in the manufacture of detergents and petroleum-based chemical derivatives.

Sulphur is a constituent of almost all crude oils and must be largely removed from products before they can be marketed. Some sulphur recovery was carried out before the war in the U.S.A. on a small scale, but it was the post-war shortage of natural sulphur that gave an impetus to the development and installation of these processes in oil refineries throughout the world. In the United Kingdom, there was the added stimulus of the need for dollar saving.

In 1952, Shell built a plant at Stanlow to recover sulphur from hydrogen sulphide, which is one of the by-products of oil refining. This plant is now producing about 15,000 tons of sulphur a year. Until recently, in the interests of the national economy, all of this production went to meet the needs of consumers in Britain. Now, however, with the easing of the sulphur supply position, some of it is to be used for the manufacture of Stanlow's own requirements of sulphuric acid.

Long-staple American Egyptian cotton growing in Southern California, an important crop in this area

Egypt's Competitors

A Survey of Producers, Real and Potential, of High Quality Cotton

C. H. BROWN, B.Sc.

In this article, reproduced from our sister Journal 'Fibres (Natural and Synthetic),' the author surveys the possibilities in producing areas other than Egypt of high quality cotton growing and discusses the technical positions of these regions. Mr. Brown, who was formerly plant breeder to the Egyptian Ministry of Agriculture, will be well known to readers by his articles in WORLD CROPS.

CONSUMERS of long-staple cotton have been deeply dissatisfied with the market manipulation of the Egyptian authorities in recent years. Although the new Neguib regime showed at first a disposition to free the market, this has now changed to a policy of Government trading at fixed prices. The system adopted is to offer both short- and long-staple Egyptian at fixed percentage premiums of 10% and 30% respectively over the current price of American Upland. These prices may appear relatively cheap to the Egyptian authorities, but arguments exist for the belief that premiums for quality cottons may rule lower in future than in the past. These considerations have not yet perhaps been appreciated at their full value in Egypt, nor does there seem there any realisation that Egyptian market intervention is a direct stimulus to other countries to push their own production of similar cotton to the maximum extent possible.

U.S.S.R.

It is true that Egypt's own position as a producer of high-quality cotton remains strong, but possibilities do exist of similar production elsewhere and the technical position of some of these producers is interesting. There is first the great unknown, Soviet Russia. Unknown because, although the figures of the main State plans are publicised, these do not, for cotton, include any breakdown into the different types and qualities. In earlier years, before the war, when the blanket of secrecy was not as thick as it is at present, it was known that the trans-Caucasian territory of Azerbijan was devoted to Egyptian varieties. Seed had originally been obtained from Egypt in the 1920s, but there were great claims in Russia of the superlative work of their cotton breeders and that strains of Egyptian origin would be adapted to other regions of Russia. Unfortunately, there seems no means at present of pronouncing on these claims, or even of knowing what proportion of the present Russian cotton area is devoted to long-staple. The only real clue is given by the fact that Russia has, in the years since the war, been interested in acquiring Egyptian cotton through barter deals with Egypt. Even this clue is slender. It might indicate the relative failure of Russia's own long-staple production or, alternatively, her desire to build up a military stockpile of this sort of cotton, whose uses in time of war expand greatly.

Uganda B.P. 52 and Peruvian Tanguis

Uganda-grown B.P.52 is in many ways a cotton comparable with Egyptian Ashmuni. A high proportion of this Uganda crop is taken by India, and this is undoubtedly a main reason why India's takings of Egyptian Ashmuni are negligible, while her takings of Egyptian long-staple are, on the contrary, important.

Another similar world cotton priced comparably to Egyptian shorts is Tanguis, grown in Peru. This most interesting cotton is longer than Ashmuni and re-

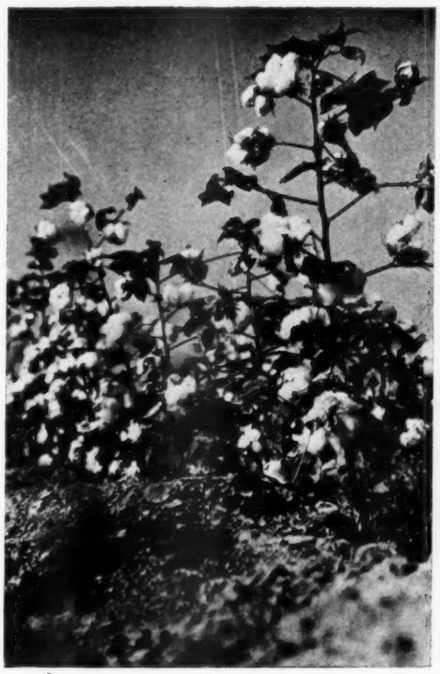
markably coarse for its length. These qualities, together with its extreme whiteness, give it a special value in the hosiery trade. Tanguis cotton has replaced all earlier types in Peru, and its production there is now on an average about 360,000 bales per year. There do not appear to be any possibilities of expansion. A smaller crop is also grown in Peru of true Egyptian type.

There is some Pima, a long-staple weak cotton of U.S. origin and one of the few crops left in the world of this variety. The fibre is not in great favour with users and, although it is long-staple, it has to be offered at prices competitive with those of Ashmuni to find a market.

In recent years there has, therefore, been a tendency in Peru to replace the Pima by Karnak, from Egyptian seed. Karnak is itself a cross of Pima origin, but gives higher yarn strength.

Sudan Gezira cotton

While the political future of the Anglo-Egyptian Sudan remains uncertain, we must for the present treat it as one of Egypt's competitors, and it is certainly as such that it is now regarded by Egyptian growing interests. The Gezira Cotton Board, who have taken over the mantle of the earlier Sudan Plantations Syndicate, market their crop both separately from and in a different manner from Egypt. Normally, bulk deals are done with both Great Britain and India for a majority of the crop, while a minority is offered at free auctions. Since some part of this is usually bought for these same two users, it follows that Sudan cotton is very little known in other important consuming countries, such as France and Italy. In India, however, and even more in Lancashire, it is regarded as a most important competitor of the Egyptian-grown product and is much appreciated on its merits.



Upland cotton ready for picking

The crop is roughly half each of two main varieties, S and L, and totals about 25% of Egyptian production. The expansion of area in future depends on further irrigation facilities and, in fact, will also depend on the agreement between the Sudan and Egypt about the provision of these. S cotton is Sakel, originally from Egyptian seed, and is closely comparable in quality with Egyptian-grown Karnak. L, as it is called, is a selection made by Lambert nearly 30 years ago and, although commonly also classed as Sudan Sakel, it is, in fact, quite a distinct variety. The plant is much later maturing and more bushy than true Sakel, while the lint, though long, is coarse. This gives it a special interest for certain end-uses, though the coarseness prevents it ever giving the full yarn-strength of the S type. Market habit tends to classify the top grades of L as a long-staple, while the lower grades normally are used in direct competition with Ashmuni, sometimes even being mixed with this.

Agriculturally, L cotton may now be considered as the base of a new 'Sudan' type as distinct from Egyptian. Genes of other cotton species have been added to it in a special breeding programme designed to increase its resistance to bacterial and virus diseases.

American-Egyptian

The production of American-Egyptian, as it is called, in the irrigated valleys of Arizona and California is technically successful. It was here that the original Pima type was selected from introduced Egyptian seed in the early years of this century. As experience showed the fibre defects of the parent Pima, this was crossed with newer Egyptian varieties, and the types of cotton now produced there are a distinct quality improvement on earlier forms. But the high cost of hand labour for picking hits this crop hard, and it is generally only considered remunerative at a high support price. In fact, the U.S. Government is now guaranteeing for this crop a price about three times that of American Upland, and much above the price at which comparable Karnak can be imported from Egypt. It will therefore be seen that the position of Egyptian type cotton in the United States is bound up with Government policy. It can be much expanded if necessary, and was so during the war, when much high-quality cotton was needed, and imports from Egypt were difficult. But in normal times policy is merely aimed at keeping it alive, with continued research, and an economic crop of just sufficient size to furnish a seed supply for expansion if the need ever arose again. A point of some economic importance is that by the support policy, coupled with import duties and quota restrictions on imported long-staple, the premiums for high-quality cotton inside the United States are maintained at a higher level than would be acceptable in purely cotton-using countries, where all types of cotton are freely imported. American users are thus to some extent insulated from the possible beneficent effects, from the consumer's point of view, of abundant and cheap supplies of long-staple cotton.

Ginning Sea Island cotton, West Indies

Picking the cotton crop in the Niger Delta

Sea Island

The West India Sea Island crop is well known. Apart altogether from the successful advertising campaign on its behalf, its position as the best cotton in the world would be bound to make it famous. This position is only strictly held by St. Vincent Superfine, which is a variety of the Sea Island crop, the majority being the long but coarser Montserrat. This variety, though much appreciated in the fine spinning trade, does not actually make a yarn strength superior to that made by cottons at the top end of the Egyptian range. The Sea Island crop is necessarily limited by the small available area on the various islands where it is now grown. Insect attacks and the better yields given by Uplands varieties have now killed the crop on the eastern United States seaboard, the original home from which it took its name.

Promising new areas

It is to the French colonies that we must look, perhaps, for a crop of long-staple which has substantial prospects of expansion in the relatively near future. The growing of Pima type has been continued, spasmodically, in both Algeria and Morocco since the early 1920s. With the recent organisation of serious research, and the construction of a series of new barrages for irrigation, the known possibilities of expansion should begin to come to fruition. It is from Morocco, probably, that the bigger cotton areas will come in the future. Here excellent alluvial plains lie only waiting for the water, which is now being brought to them. Present varieties are Pima in Morocco and Karnak in Algeria, both producing a staple acceptable to spinners, but intensive research may naturally, in the future, show other types to be better adapted.

In the Upper Niger Delta, in the French Sudan, appears the only other important area in the world which, in the near future, may grow cotton comparable with Egypt's own. Here there are hundreds of thousands of acres, flat and irrigable, which will require an immense amount of development, but have considerable possibilities at the end of it. Serious production of Egyptian type cotton has only just started there. Conditions being similar climatically to the Anglo-Egyptian Sudan, it is with L seed from the latter country that trial is first being made.

Egypt must watch competition

All in all, we may say that, although Egypt had a century's clear start, the type of cotton evolved there has shown it can be adapted, perhaps with local modifications, to many other countries. Thus, although Egypt's own production will certainly still be needed, she cannot afford to rest on her laurels and ignore her competitors.

It has sadly to be recorded that no success appears yet to have attended the attempts to grow long-staple cotton in India or Pakistan, although hopes have from time to time been held out and much thought has been devoted to it.

Photo: P. 454, United States Information Service.

OEEC Agricultural Training Courses Seminar

In its drive to obtain an improved output of European agricultural products and to provide consumers with higher-quality goods at lower cost, the Organisation for European Economic Co-operation held a seminar in June at which 25 experts from 13 member countries discussed how future plans for agricultural training courses and workshops should be put into effect with the utmost efficiency. Up to the end of May ten of these courses had already taken place, organised by OEEC's European Productivity Agency under arrangements with the United States Foreign Operations Administration.

The training courses so far undertaken have proved of great value in enabling member countries to acquire the experience and knowledge of leading experts and research workers in all branches of agriculture. They have also provided an opportunity for participants to exchange ideas and to seek solutions for problems of local or general interest. The experts attending the seminar for improved organisation, conduct and follow-up of agricultural training courses and workshops have studied the subject against the background of these first 10 courses. Many of them are already acquainted with such activities and are likely to be responsible for future organisation on a national or international scale; others, while they have not previously taken part in international organisational work, have long-standing experience in such activities as in service training for advisers. As a result of the seminar, all have gained useful knowledge on the many problems involved in the organisation of training courses and work shops.

In general, the experts confirmed that past methods in the conduct of training courses and workshops should be continued with some minor alteration of detail. They also recommend that future courses which have not already been arranged should not normally be longer than about two weeks owing chiefly to the difficulty experienced by senior key personnel in being too long away from their official posts. It was agreed that the present activity would not attain its full value unless adequately followed up at the national level. It was recommended that each country should set up some type of co-ordinating body closely associated with the advisory services which would be responsible for dealing with the organisation of international courses held in the country, for arranging participation in courses outside the country, and for initiating and co-ordinating various types of national-level courses.

Indian River Valley Irrigation Schemes

JOHN GRINDROD, B.A. (Com.)

Under British rule, the great extension of irrigation was one of the greatest benefits conferred upon the Indian sub-continent. The Indian Government is now increasing and extending irrigation facilities to meet the increasing demands for food and raw materials of the rapidly growing population. An outline of the many projects in course of execution or contemplated is given in the following article.

OF all the factors which have retarded the development of Indian agriculture probably the first on the list is the difficulty of water supply. Much of the land suffers either from a deficiency or an excess of water or, alternately, from both. The result has been that not more than about one-third of the cultivable land has been brought under the plough. The harnessing and taming of the river waters, coupled with an efficient system of irrigation is, therefore, one of the most urgent needs of India today. It is a need which will most certainly have to be met if India is to cope with her serious food problem. This is not merely a temporary disequilibrium between supply and demand but a sign of the continually growing pressure of population upon the food producing capacity of the country.

Indian water resources

India has ample water resources, but at present only about 6% of them are being utilised. Nevertheless, India claims already to have more acreage under irrigation than any other country in the world. Before the partition of the country into India and Pakistan the irrigated area was 72 million acres out of a total cultivated area of 298 million acres, or 24%. Since partition this proportion has fallen to 19%, represented by 48 million acres irrigated out of a total cultivated area of 251 million acres. By taking advantage of improved methods of high dam construction the possibilities of developing India's water resources are enormous. By this means, the monsoon waters, which have hitherto caused flooding, loss of life of both men and cattle, destruction of crops and soil erosion, could be conserved for use during dry periods. In addition, the control of malaria, now prevalent in many places, would be made easier.

Central Indian authority for irrigation

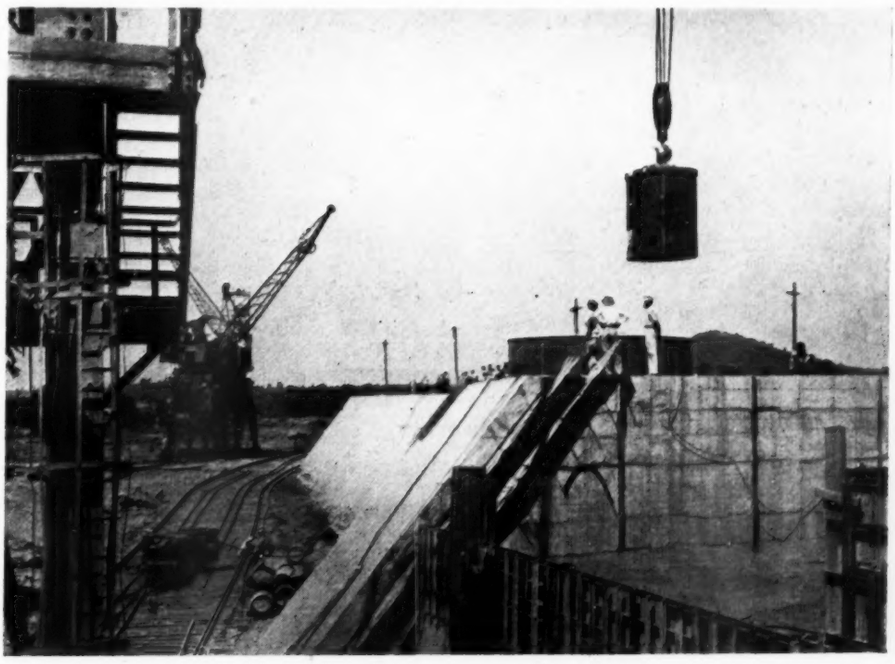
Until as recently as 1945, the initiative for preparing water development schemes rested entirely with the Indian provinces. There was no central organisation to encourage the study and planning of schemes on major rivers involving more than one provincial unit. This was remedied by the creation by the Central Government of the Central Waterways Irrigation and Navigation Commission and the Central Technical Power Board. Not only do these bodies now assemble data required for proper water planning but they give expert advice and direction in the investigation of schemes formulated by the provinces. In recent years, they have investigated and planned several major multi-purpose schemes which form the backbone of the national effort to make the fullest possible use of this natural source of power and fertility.

When, after the war, India achieved national status, one of the most important things her government did was to set up a planning commission, in March 1950, ' to make an assessment of the material, capital and human resources of the country ' and to formulate a plan for the ' most effective and balanced utilisation of the country's resources.' The commission's first five-year plan was approved by the Indian Parliament on December 19, 1952, and incorporated many findings and proposals in respect of the development of water resources.

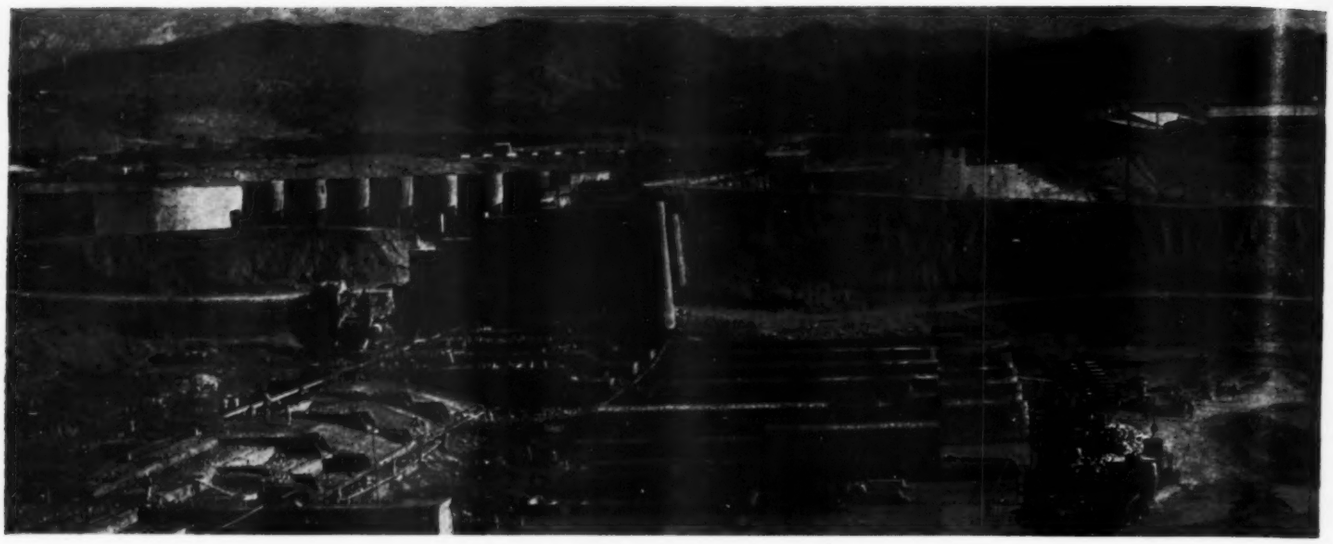
The irrigation programme

The programme of irrigation and power development, the commission suggested, has to be viewed as a major long-term objective. This should cover a period of 15 to 20 years to double the area under irrigation and to secure the additional production of power amounting to seven million kilowatts. It is estimated to cost about Rs.20,000 million.

While the optimum requirements have thus been set out, the minimum programme during the plan period 1951-56 has necessarily been drawn up on the basis of available resources. At present, the Central and State Governments have under way 135 projects in different parts of India. Of



Concreting in progress at the Hirakud project



A general view of the Bhakria Nangral project

these, 11 are multi-purpose, 60 purely irrigational and 64 purely power projects. Twelve of the 135 projects are classed as major schemes costing more than Rs.100 million each. Eight of the major schemes are multi-purpose in scope, three are power schemes only and one is an irrigation scheme only.

The first five-year plan aims mainly at the completion of the projects already under construction. These are estimated to cost, on completion, Rs.7,650 million. Of this, a sum of Rs.1,530 million had been spent up to March 1951. During the two years 1951 to 1953, a sum of about Rs.1,900 million had been spent on these projects, against Rs.2,060 million envisaged in the plan, out of a total provision of Rs.5,180 million for the schemes under construction for the full five-year period.

These schemes are calculated to irrigate an additional area of 8.5 million acres and to generate 1.08 million kW. of additional power. The ultimate irrigation value of the schemes is placed at around 17 million acres.

Year by year expansion has been scheduled as shown in Table 1.

TABLE 1

Year	*Expenditure (Rs. millions)*	*Additional Irrigation (acres-progressive)*	*Additional Power (Total over 1950-51, kW.)*
1951-52	850	646,000	58,000
1952-53	1,210	1,890,000	239,000
1953-54	1,270	3,555,000	724,000
1954-55	1,070	5,749,000	875,000
1955-56	780	8,533,000	1,082,000
Ultimate	—	16,942,000*	1,465,000
New scheme	400	—	—

*Not including benefit from new schemes

The three outstanding projects

Outstanding among these projects are the three large multi-purpose schemes of the Central Government at Bhakra-Nangal, Damodar Valley and Hirakud. These are planned to provide, respectively, additional irrigation for 1,293,000 acres, 470,000 acres and 800,000 acres by the end of 1956 and, ultimately, for 3,424,000 acres, 1,326,000 acres and 1,930,000 acres respectively.

The Bakra-Nangal Dam

The principal features of the Bhakra-Nangal Dam Project are the construction of a main storage dam 680 ft. high—the world's highest straight gravity dam—on the River Sutlej near Bhakra, about 50 miles upstream of Rupar, where the river enters a narrow gorge; a diversion dam at Nangal, about eight miles downstream; a level canal with two power houses and a network of canals to irrigate annually over 3.4 million acres in a cultivable area of over 5.6 million acres.

Work on this project is progressing satisfactorily both at the dam site and in the Bhakra canals, comprising 518 miles of main and branch canals and 2,000 miles of distributory channels. It is expected that most of the channels will be completed in time to provide non-perennial supplies to the Bhakra areas during 1954. Partial irrigation has already begun. About 19,000 acres were irrigated in 1951-52 and about 100,000 acres during 1952-53.

The Damodar Valley Project*

The Damodar Valley Project involves the ultimate construction of no fewer than eight dams across the Damodar River or its tributaries, a thermal station at Bokaro and an irrigation system. The first phase of the project includes the Bokaro thermal station, the Tilaiya Dam with a power station, the Konar Dam, the Maithon Dam with a power house, the Panchet Hill Dam, the Durgapur Barrage and canals and a transmission line system.

This wandering and capricious river rises in Chota Nagpur at an elevation of 2,000 ft. and after flowing 180 miles in the State of Bihar it enters the deltaic plains of Bengal and ultimately joins the Hooghly. In its earlier stages, it flows very rapidly, eroding land and collecting silt, while in its lower reaches it becomes sluggish, discharging its flood-volume and silt along its banks. The river commands a drainage area of 8,500 sq. miles of which 6,960 sq. miles form the catchment area of the upper Damodar River just above its confluence with the Barakar. Most of the average of 47 in. of rainfall of its upper valley occurs during the monsoon months.

Patterned on T.V.A. lines, the Damodar Valley Project has behind it the experience of an expert who helped plan the Tennessee project. As well as keeping in check the floods which, in the past, have caused great loss, especially in Bengal, the project will make possible the irrigation of over a million acres of land in Bengal and Bihar, though most of this lies in Bengal State.

* An account of the Damodar Valley Project by Mr. S. Ramanath appeared in WORLD CROPS, Vol. 5, p. 307.

TABLE 2

Project	Additional Irrigation Benefits expected by 1956	Ultimate Additional Irrigation Benefits
	(acres)	(acres)
Kakrapar (Bombay)	391,000	652,000
Tungabhadra (Madras and Hyderabad)	315,000	700,000
Machkund (Orissa)	(Power only)	(Power only)
Mayurakshi (West Bengal)	600,000	600,000
Lower Bhawani (Madras)	130,000	207,000
Ghataprabha (Bombay)	45,000	100,000
Gangapur (Bombay)	15,000	45,000
Others	4,742,000	7,615,000

Although most of the irrigation water will be used in Bengal, a scheme for improving the barren, soil-eroded land of Chota Nagpur in Bihar has been proposed. Here, in many parts, the land is deeply gullied and unable to absorb rain water. For this area, a basic replanning of the pattern of agriculture is deemed necessary. A well-planned scheme of afforestation is thought most suitable. Under this system, the sub-soil water table would gradually be raised to higher levels, increasing soil fertility. Better grazing land would become available and, with a plentiful supply of timber, dung would no longer be used as fuel. Mulberry cultivation for a silk industry, lac cultivation and the growing of bamboos are planned.

Progress on the scheme includes the near completion of the Bokaro thermal station and the completion of Tilaiya Dam, both of which have recently been officially opened.

The Hirakud Dam Project

Representing one of three units envisaged for the development of the Mahanadi Valley, the Hirakud Dam Project is designed to control floods in the deltaic area of the valley, to irrigate 1.9 million acres of land and to generate nearly 200,000 kW. of farm power. The principal features of the project are a main earth dam across the river about eight miles upstream of Sambalpur, a subsidiary dam at the tail end of the power channel and a network of flow and lift irrigation canals. More than half the work of excavation of the canal system has been completed and, according to present expectations, both irrigation and power will be available from the Hirakud Project in 1955, as envisaged in the five-year plan.

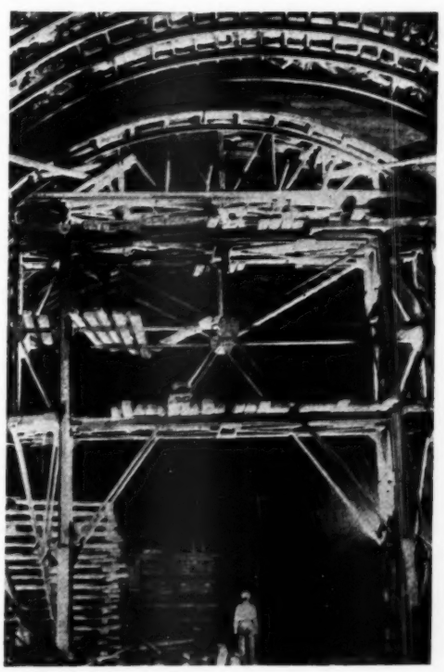
Smaller State schemes

Other smaller state schemes are listed in Table 2.

Many of these have been under way during the last few years and are expected to be completed between 1953 and 1956. During the two years 1951 to 1953, 1,310,000 acres of new land were irrigated by State projects.

Other schemes investigated and found feasible of execution are dependent upon the availability of finance, the extent of foreign aid and mutual assistance among Commonwealth countries. Of the more important of these are the Kosi, Krishna-Pennar, Chambal, Koyna and Ukai schemes.

To maintain continuity of development of river valley schemes the planning commission has earmarked an annual expenditure of Rs.4 million for systematic investigations so that proposals will continue to be put up to the Government for sanction. Several of these investigations are at present being undertaken. For instance, the Sabarmati project envisages the construction of a dam for irrigation and power production. Some of the power would be used to work 520 tube wells to irrigate an additional area.



A concrete gantry in position for concreting 50-ft. diameter inversion tunnel at Bhakra Dam

The menace of soil erosion

One of the menaces to the success of these river valley schemes is soil erosion. This was emphasised by Indian Finance Minister Chintaman Deshmukh when he addressed the annual session of the Soil Conservation Society of India in New Delhi on February 6 last. He said that the very life of the Damodar Valley and Kosi Dam projects was imperilled because of the advancing soil erosion to the catchments of these projects. Unless proper conservation measures were taken the dams might have to be rebuilt in the next generation. He suggested a reconnaissance survey to assess the magnitude of the erosion problem.

Conclusion

India is now investing some Rs.1,000 million every year in these hydro-electric irrigation projects and some benefits are already being derived from them. During the first two years of the five-year plan the Central Government multi-purpose projects irrigated some additional 105,000 acres of land and produced 54,000 kW. of power, while the State schemes brought into use an additional 1,310,000 acres of newly irrigated land and generated an additional 261,000 kW. of power.

Photos : Press Information Bureau, Government of India.

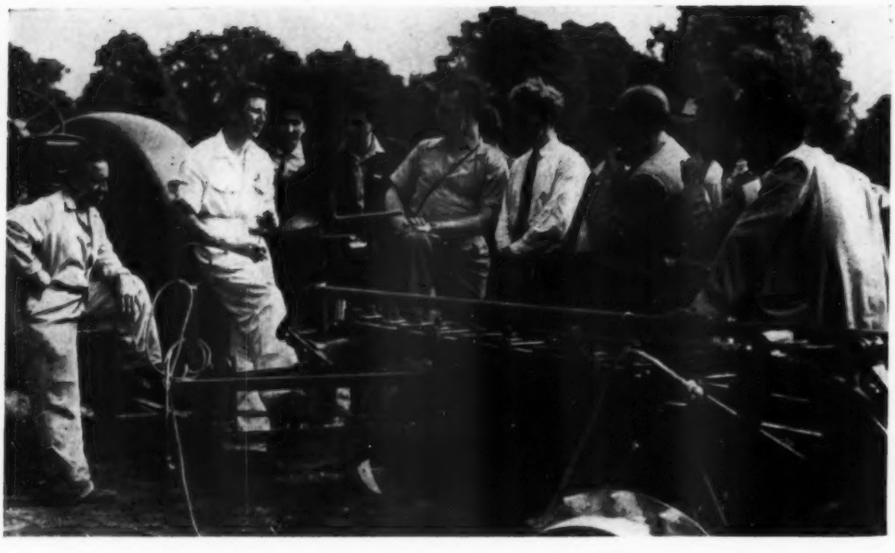
Huntings' Conference

Delegates from all parts of the world attended the aerial survey conference of the Hunting group of companies which was held in London recently. The conference was called to enable the associated companies of the group to exchange ideas on aerial survey techniques and equipment.

Czechoslovakian Research Institute

A new research institute designed to achieve improvements in agriculture and forestry began work on April 1 in Czechoslovakia as part of the national Academy of Agricultural Science. Among its tasks will be the study of the effects on soil of shelter belts of trees. The influence of moisture, of irrigation systems and reservoirs on various agricultural products will also be examined and useful findings incorporated into general practice where increased yields are sought.

The new organisation will profit from the experience of a commission previously responsible for this kind of research.



(*Left*) **A class in progress at the school and** (*Right*) **a demonstration under rice field conditions**

The Massey-Harris-Ferguson Course in Mechanised Tropical Farming

One of the results of the union of Massey-Harris and Ferguson has been the considerable increase in the range of agricultural equipment which they can offer to farmers all over the world. The engineering experience of these two firms is able to produce and to sell implements for use in almost every sphere of farming practice. The company can supply, for example, in addition to the needs of farmers in temperate zones, equipment suitable for the mechanisation of rice fields in the Far East, the tea and coffee plantations of India and the rolling savannah and swamp and plateau areas of Africa.

For the benefit of Colonial agricultural officers and others concerned with the problem, a course in tropical agricultural equipment, organised by Massey-Harris-Ferguson, took place at Ashorne Hill, the British Iron and Steel Corporation's conference centre near Leamington Spa, during the first week of September. The course was attended by between 70 and 80 students. The Overseas Food Corporation was represented by 18 students and there were 26 Colonial Service agricultural officers from Tanganyika, Nigeria, Gold Coast, Trinidad, Malaya, Uganda, Kenya, Cyprus and Sierra Leone. In addition, there were several overseas agricultural students, a tea planter, two Yugoslavs, two French Colonial officers and an Indonesian trader.

For the course, the students were divided up into a series of groups, each of which received identical lectures and demonstrations, the object being, by keeping the groups small, to ensure that each member received individual attention.

The course included lectures and demonstrations on the use of tractors and implements under tropical conditions. The operations dealt with included ploughing and the preparation of seed beds, mechanical planting of crops, row crop farming, rice cultivation and many other subjects. In connection with it, collections of implements were on show in the fields adjoining the institute, and the working of the tractors and implements demonstrated. A special feature was the flooding of a small area to reproduce conditions met with in rice fields in the tropics, in which implements and tractors modified to suit conditions in rice fields were shown working.

The course was judged to have been of considerable practical value by all who attended it.

The Fourth World Forestry Congress

It has been announced that the fourth World Forestry Congress will take place in India in December 1954. It is to be held under the auspices of the Food and Agriculture Organisation of the United Nations. The first three World Forestry Congresses were held in Europe, respectively in Rome, Budapest and Helsinki. The last of these was held in 1949, when the desire was expressed that further meetings should be held at regular intervals and that a special Silvicultural Congress should be organised regarding the tropical countries. The Government of India, at the request of FAO, has accepted the responsibility of organising the fourth World Forestry Congress and has invited all governments, forest services, forest and forest industry organisations and other organisations interested to participate. The Congress will be held at Dehra Dun from December 11 to 22, 1954. The subjects of the conference will include ' The Present Status of Forest Protection and Forest Management in the World,' ' Protective Functions of the Forest, Productive Functions of the Forest,' ' Forest Products Utilisation and ' Tropical Forestry.'

An organising committee has been appointed by the Government of India to make preparations and arrangements for the conference in consultation with FAO.

The committee will also be responsible for the publication of the proceedings of the congress.

The address of the organising committee is : c/o M. D. Chaturvedi, Inspector-General of Forests, Ministry of Agriculture, New Delhi, India.

Conophor Oil

G. T. BRAY, F.R.I.C.

Colonial Products Laboratory

Conophor oil is obtained from the seed of* Tetracarpidium conophorum, *a native of West Africa. It has been shown that the oil can be successfully substituted for linseed oil in paints and varnishes. The plant is a woody vine, and in this article, reproduced from our sister journal 'Paint Manufacture,' the possibility of introducing it into cultivation is discussed.

DURING World War II, when there was a great scarcity of linseed oil and other oils for use in the paint trade, considerable efforts were made to ascertain whether there existed in the Colonial Empire any other oilseeds which yielded oils suitable for this purpose, and if so, whether adequate supplies were available, or could be made available by cultivation. One of the most promising of the oilseeds yielding drying oils, which was selected for further investigation, was the Awusa or N'gart nut, from which is obtained conophor oil.

This nut plant is obtained from *Tetracarpidium conophorum* Hutch. and J. M. Batz, formerly known as *Plukenetia conophora* M.Arg., N.O. Euphorbiaceae. This plant is a rapidly growing woody vine, which occurs in tropical West Africa, particularly in high rain forest areas. Although it is usually found growing wild, yet in some countries—*e.g.* Sierra Leone and Southern Nigeria—it is cultivated to some extent in recently cleared land. It starts to fruit usually in its third year and fruiting normally takes place in August-October, but in some cases also in April-May. The fruit varies in length from 2½ to 3 in. and in breadth from 1 to 1½ in. Each of the four compartments of the fruit contains an almost spherical seed, composed of a thin, very hard black shell enclosing a white oily kernel. A sample of the fruits obtained from the Belgian Congo yielded on examination the following figures:

FRUITS:	
Fibrous pericarp	44.5%
Seed	55.5%
Average weight of a fruit	48.5 gm.
SEEDS:	
Kernel	62.7%
Shell	37.3%
Average weight of a seed	6.7 gm.
KERNELS:	
Average weight	4.2 gm.

Suitability for paint

The seeds, which have a bitter taste reminiscent of kola nuts, are eaten by the natives, a fact which tends to raise the cost of them.

The kernels contain from 44% to 60% of a golden-yellow oil, possessing a taste and odour resembling those of linseed oil. It has been proved by experimental trials that the kernels may be safely fed to animals and the oilcake left after the removal of the oil is also edible and is eaten by the natives.

The analytical figures of conophor oil usually fall within the following ranges:

Specific gravity at 15.5°C.	0.936-0.939
Refractive index at 15°C.	1.4835-1.4870
Saponification value	190-195.4
Iodine value (Wijs) %	198-206
Unsaponifiable matter %	0.2-0.6
Solidifying point of acids	24-25°C.
Hexabromides %	47.7

About 1943, the Colonial Products Research Council undertook the study of the suitability of conophor oil for the paint industry. Supplies of the nuts were obtained from Nigeria for the purpose of this investigation. At the start of this enterprise it was found that, owing to the seeds being unusually rich in lipolytic enzymes, the free fatty acid content of the oil in them rapidly increased immediately after harvesting. In fact, a test showed that after being carefully stored for 11 months the seeds yielded an oil containing a free fatty acid content as high as 76.8% (as oleic acid). Fortunately, it was discovered by K. T. Hartley, Senior Agricultural Chemist at Ibadan, that keeping the seeds at 100°C. overnight destroyed the activity of the enzyme and enabled oil with a satisfactorily low acidity to be obtained even after storage of the seeds for several months. It was shown later that the heat treatment need not exceed a few minutes.

The Colonial Products Research Council in their investigation submitted samples of the seeds and oil to Prof. T. P. Hilditch of the University of Liverpool and to Dr. L. A. Jordan, Director of the Paint Research Station at Teddington.

At Liverpool, the work carried out concerned the determination of the chemical composition of the oil. A paper giving the results of this work by F. D. Gunstone, T. P. Hilditch and J. P. Riley showed that conophor oil is similar in qualitative composition to linseed oil but contains a higher proportion of linolenic acid in its component acids. Its composition was determined as being:

	%
Linolenic acids	64-68
Linoleic acid	10-12
Oleic acid	10-11
Saturated acids	10-12

At the Paint Research Station, trials were carried out in which conophor oil was compared with linseed oil, when used in the preparation of stand oils, paints and varnishes containing copal ester and phenolic resins. The results of these trials showed that conophor oil containing driers dried more quickly than linseed oil and thickened more rapidly under heat treatment. In paints with various pigments and driers the superior drying properties of conophor oil were very evident.

Cultivation

In view of the promising potentialities of conophor oil for use in the manufacture of paints and varnishes, the question naturally arose as to the possibility of obtaining regularly supplies of conophor seed in commercial quantities. Investigations indicated that this was not very probable. Accordingly, it was decided to cultivate the vine. But, unfortunately, little cultivation had been undertaken in the past and there was very little experience upon which to base efficient methods of cultivating this vine on a plantation scale. The Agricultural Department, Nigeria, undertook to carry out the necessary preliminary experimental tests. In 1947, they established at 19 different sites in the western region of that country small trial plots with a view to testing methods of establishing and cultivating the vine, which requires, so it was thought at that time, wide spacing, shade and natural support of a considerable height. These trials were continued in 1948 and they showed that some of the plants started bearing in three years. The growth was irregular, but satisfactory results were obtained if the seeds were fresh and planted in reasonably fertile soil under light shade and against a secure support. It was recommended that

planting should be done as soon as fresh seed could be obtained in June, so that the plant is well established before the commencement of the dry season. If the vine can reach the light at 8-10 ft. high, the growth of secondary shoots which bear flowers is accelerated. It was considered from these tests that if the methods used in them were followed cultivation of this vine is easily within the capacity of the average farmer. These tests also indicated that germinated seeds are preferable to seed planted *in situ*. Both shade and good soil with high organic content are necessary. Trials were in progress in 1948 to determine the optimum spacing and shade requirements and whether manuring with organic or artificial fertilisers was sound. Propagation by vegetative means was tried. The use of terminal cuttings of green shoots, thin woody cuttings, portions of thicker woody stems and root cuttings was not successful. The results of these trials carried out in 1949-50 confirmed the opinion that the prospects of establishing this vine as a plantation crop are very promising.

Although it was originally considered that heavy shade was necessary for the cultivation of the conophor vine, tests made in 1950-51 at Ijebu Ode, Nigeria, indicated that this may not be true as at this plantation it was found that unshaded plants gave approximately twice as heavy yields as those grown under medium and heavy shade. Should this finding be confirmed, it will mean that seed grown on unshaded vines will be easier to handle as it will be more accessible.

Commercial growth

Further and larger-scale trials were started by the Department of Agriculture, Nigeria, in 1950. Early in that year, the Secretary of State for the Colonies approached the Nigerian Government with regard to an extensive trial on a commercial scale. He had advised that the cost entailed in establishing a 100-200 acre plantation would be well worth while both in the interest of Nigeria and of the paint industry. An expenditure not exceeding £5,000 was authorised for an experimental plantation at Ijebu Project. In 1950, at Ijebu 10 acres were established by planting seed at stake at 20 ft. by 10 ft. spacing. Unfortunately, about half an acre was subject to waterlogging and on this most of the vines died. Draining was carried out in 1951 and the losses made good by planting seed at stake in 1952. During 1951, another 46 acres were established by transplanting seedlings raised in a nursery. Of the two methods tried planting at stake proved much more successful. Only 50% of the 1951 transplants survived; these losses were replaced in 1952.

The Awusa nut, from which conophor oil is extracted, is shown here growing on the vine

A further 44 acres of new plantings were established in the year 1951-52. At that period all the surviving 1950 plantings had made good growth and were flowering well. The vines had been trained on trestles. The vines were found to have made good growth even on poor sandy soils. The best results were obtained under direct sunlight as was shown when on one plot half the acreage was clear felled and the other half only partially cleared of forest cover. The results of these larger-scale trials differ in one or two instances from those of the earlier small trials.

Latest results

The present opinion is that the conophor vine will take from four to five years to come into substantial bearing and that the yields will increase steadily for several years after. The cost of bringing an acre into full bearing is estimated at £100. The possible yields and the economics of the enterprise are not yet known. It therefore remains to be proved whether cultivation can be achieved at a cost that will permit production at a competitive level.

In 1952, it was not found possible to extend the acreage at Ijebu except for a small area adjoining the 1951 planting. Much difficulty has been experienced in establishing full stands of suitable supports for the vines, and it is considered that the best policy may be to abandon the 1951 plantings in favour of the oil palm. In the absence of hog plum or other support the vines are particularly susceptible to damage during cutlassing. Should it be decided to abandon the 1951 plantings, an attempt will be made to develop a new plantation where the vines will be trained up naturally occurring sapling supports left for the purpose at the felling stage of clearing.

In Malaya, also, small-scale trials have been started with seed obtained from Nigeria. Of the seeds planted, 80% germinated. The vine is being tested in as many ecological zones as possible, different host trees being used as supports. So far the results are quite promising.

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Photo: Information Officer (Marketing), Lagos, Nigeria.

Technical News

The November issue of *Petroleum* includes 'Plant Calculations for Petroleum Technologists—1' by T. K. Ross, 'Azeotropic and Extractive Distillation—2' by G. A. Dummett, and 'Photography in Oil Research—2' by A. J. Insall and J. W. Drinkwater.

Chemical and Process Engineering for November contains 'Automatic Control of Distillation Processes—1' by A. Pollard. Chemical Engineering Reviews in this issue include 'Mixing' by D. F. Riley, and 'Metallurgy' by H. A. Holden.

The contents of *Paint Manufacture* for November include 'Accelerated Weathering of Paints' by W. Toeldt and 'Physics in Paint Manufacture' by N. Corcoran.

Carnauba Wax

Carnauba wax is produced from the leaves of the carnauba palm which is found in Brazil. In this article, the harvesting, production and uses of this valuable vegetable wax are described.

CARNAUBA WAX is a hard, high-melting, lustrous wax produced from the wax film coating the leaves of the carnauba palm (*Copernica cerifera-Arr. Cam. Mart.*), which is found in the semi-arid region of North-Eastern Brazil in the states of Maranhão, Piaui, Ceará, Rio Grande do Norte, Paraiba, Pernambuco and, to a lesser extent, in Bahia, Goiás and Pará. The carnauba palm is a slender, slow-growing tree, averaging 35 to 50 ft. in height, although occasionally trees on very favourable sites attain a height of 90 to 100 ft. The surface of the lower two-thirds of the trunk is rough and scaly, the flowers numerous and tiny, and the fruit grows in bunches. The fan-like leaves radiate from the crown of the tree. The leaf stems vary from 25 to 29 in. and the leaves from 17 to 19 in. in length, although a giant variety growing along the banks of the Acarau River possesses leaves from 40 to 43 in. in length with leaf stems up to 50 in. long.

The wax forms a protective coating on the leaves and when the leaves are dried it flakes and is beaten off, melted and moulded into cakes. A drought increases the yield of wax, but severe droughts over a period of years may kill the tree. Young trees begin to produce wax after eight or 10 years. If only a limited number of leaves are harvested annually, the carnauba palm will attain an age of more than 100 years.

Properties and uses

Carnauba wax is composed largely of ceryl palmitate. According to Lekowitch, it contains 47.95% of fatty acids and 13.5% of alcohols. Various investigators have reported an acid value of 4, an iodine value of 10.1 to 13.5 and a saponification value of 78 to 80. The hard, vitreous, yellowish wax melts at 85°C. and has a specific gravity of 0.995. It is soluble in alcohol and in alkalis. Having three times the viscosity of beeswax, it is used to harden beeswax, ceresin and paraffin.

The uses of carnauba wax are numerous. Fully 70% of the production of the wax goes into the manufacture of floor waxes and carbon paper. It possesses the property of being self-polishing in liquid floor waxes. In carbon paper, it is non-greasy and non-spreading. It is also used in the manufacture of shoe and furniture polishes, gramophone records, sound films, electric insulators, soap, candles, lubricating oils, leather finishes, and for blending with other waxes for coating compounds. It enters into the composition of waxes for coating motor cars, buses, lorries and railway equipment. These retard deterioration of finish and provide a lustrous weather-resistant coating. These composition waxes are also used as the final finish for asbestos shingles as well as for the final coating in the manufacture of mastic tile and linoleum.

Applied to the surface of natural and synthetic rubber products, they not only improve the appearance, but they retard oxidation, sun-cracking and marring. Burnishing wax in the shoe industry is carnauba wax blended with other waxes. Wrapping paper, cardboard, textiles and industrial machinery are waterproofed with it. Besides waterproofing, it is used in the paper industry for beater sizing, calender sizing and for coating purposes. Carnauba wax goes into various salves and ointments, artificial fruits, plasters, matches, cable coverings, paints and varnishes. A coating of this wax on the exposed surface of aeroplanes not only provides protection, but reduces 'skin friction,' thereby enabling them to increase their speed.

The carnauba palm

All parts of the carnauba palm are utilised by the natives. The trunk is widely employed in building construction: the entire trunk is employed as corner posts and beams, while the split trunk furnishes rafters and roofing laths. In the State of Ceara, some houses are constructed entirely of carnauba—walls, framing, doors, windows and roofing. Carnauba piling is noted for its resistance to marine borers in salt and brackish water.

Besides furnishing wax, the leaves make excellent thatched roofs and are woven into various articles, such as hats, ladies' handbags, slippers, mats, baskets and the lining of pack saddles. The young leaves yield a strong fibre used for ropes and hammocks. The leaf stems are used for venetian-type windows and doors, fences and bed slats. The head of the leaf stem is used locally as a substitute for cork.

The pericarp of the fruit is sweet and edible for humans and livestock. The green leaves are sometimes cut to sustain cattle in dry years. The *palmito* (or palm heart) from the crown of the tree is largely consumed by the native population during periods of drought. The heart of the young palm also provides a starch similar to manioc flour. Owing to its natural beauty, the carnauba palm is frequently planted in parks and gardens for ornamental purposes.

Harvesting the wax

Harvesting is carried out mainly by hand during the dry season, from September to December. The work is done by hired labourers. Two cuttings are made each season, with a lapse of about 60 days between cuttings. With a curved, sickle-like knife fastened to the end of a long pole, the worker cuts the leaf stems and collects the leaves as they fall to the ground. Care must be used in selecting the leaves to be harvested. If very young leaves are cut, the tree will slowly die; if fully-matured leaves are cut, they yield very little wax. Selection is based on the position of the leaves on the tree. Young leaves grow upright and then of their own weight bend outward and downward as they mature. The number of leaves harvested at each cutting varies from 7 to 15, depending on the age of the tree and the site where it grows.

The cut leaves are sun-dried for three to five days, during which time their wax coating becomes a flour-like dust. Drying is done either in open fields or in walled enclosures which permit exposure to the sun while affording protection from the wind. In a windproof shed, the dried leaves are beaten to liberate the wax dust, which is placed in clay vessels and melted or mixed with a small quantity of water and boiled. When melted, the wax is strained through a coarse cloth to remove some of the impurities and then allowed to cool. The soldified mass is broken into small pieces and packed in bags.

Men v. machines

The wax obtained from new leaves is of the greatest commercial value. Older leaves yield a darker, less valuable wax. Each leaf yields from 5 to 15 gm. of wax and the average yield of a tree varies from 60 to 100 gm. A number of machines have been invented to extract the wax from the dried leaves. The best shred or cut the leaves, then beat the shredded material to remove the wax, which is screened mechanically, after which it is removed by a suction apparatus to airtight bins. Many of the large landowners have installed these machines. However, the wax produced is usually not of as high quality as the wax prepared by hand methods. Mechanical sifters do not remove all the bast fibres and cellulose; nevertheless, they are being constantly improved. The largest and most modern plant was installed by Cia. Johnson S.A. in the Municipality of Maranguape several years ago. This company purchased leaves from other landowners in the vicinity and dried them mechanically; this enterprise, however, did not prove profitable and operations were suspended.

Cost of production

A recent study revealed that the cost of production of carnauba wax was Cr.$20.5 per kilo with a wage scale of approximately Cr.$2.5 per hour. This study was based on a native stand (*carnaubal*) of 3,000 trees per hectare (2.47 acres). The following table shows a breakdown of the cost :

	Cr.$
Cutting 60,000 leaves (800 man-hours)	2,000
Transporting 60,000 leaves (40 man-hours)	100
Drying 60,000 leaves in sun	750
Beating and gathering wax dust (1,400 man-hours)	3,200
Melting wax (80 man-hours)	100
Total	6,150

Wax obtained from 60,000 leaves: 300 kilos.
Cost of production per kilo: Cr.$20.5.

Harvesting the wax. With a curved sickle-like knife fastened to the end of a long bamboo pole, the worker cuts the leaf stems and collects the leaves as they fall to the ground

The breakdown shows that each tree yielded 20 leaves which, in turn, yielded 5 gm. of wax per leaf or 100 gm. of wax per tree. This cost figure is high owing to the high wage scale. Landowners commonly contract for the extraction of wax on their properties on the basis of Cr.$10 per kilo. As carnauba wax is now worth from Cr.$32.66 to Cr.$46.66 per kilo. in Fortaleza, depending on the quality, it is evident that there is ample margin for profit after deducting transport charges and taxes.

Wider mechanisation sought

Prices of carnauba wax are still considered high by the consuming countries. In many cases, inferior synthetic substitutes are widely used. In order to prevent markets abroad from declining through competition from synthetics, Brazil's Ministry of Agriculture recently asked Prof. Charles J. Marsel of New York to discuss with Brazilian firms engaged in the carnauba industry, engineering processes for reducing the cost of carnauba wax extraction while maintaining the high quality of the product. He has already made chemical analyses of wax samples in an attempt to establish standard specifications. The American Wax Importers' and Refiners' Association sponsored the research.

According to Prof. Marsel, the method of carnauba wax extraction and processing must, and can be, further mechanised. He hopes to recommend procedures for testing and controlling quality at the source of extraction. He will also seek to introduce new engineering techniques for extraction and processing. Filters that at present remove cellulose and foreign plant material from the wax, he says, also reduce the potential yield. He believes that more pure wax can be recovered through better engineering methods.

Export prospects

The annual production of carnauba wax is approximately 10,000 tons, of which 80% is produced in Ceará and Piaui. Production is about equally divided between these two States. Domestic requirements are about 2,000 tons and the rest is exported. About 70% of the annual production goes to the United States. Last year, 11,601 cwt. went to Britain, valued at £509,298.

Until recently, the Bank of Brazil financed production on the basis of Cr.$580 to Cr.$720 per arroba (33 lb.), depending on the grade. These prices were above the world's market price. Consequently, the consumers of carnauba wax abroad substituted other waxes, both natural and synthetic, as far as possible, and large stocks of carnauba wax accumulated at the exporting centres in North-Eastern Brazil. There was no incentive to reduce the cost of production while this basis of financing prevailed as the producers felt that the Government was always ready to step in with support through the Bank of Brazil.

Fortunately, the financing of the production of carnauba wax was discontinued a few months ago and it is to be expected that prices will now go down sufficiently for sales to be resumed on a large scale.

Export grades

The wax is transported from the fields and farms to the shipping centres, where it is classified and repacked in burlap bags for export. Five commercial grades are recognised as follows:

Type 1 (*primeira*) is a clear yellow wax with not more than 0.5% of impurities.

Type 2 (*mediana*) is a greyish yellow wax with not more than 1% of impurities.

Type 3 (*caúipe*) is a clear light brown wax with nor more than 1.5% of impurities.

Type 4 (*gordurosa*) is a dark coloured wax with a maximum of 2% of impurities.

Type 5 (*arenosa*) is a greenish, greyish or whitish wax whose colour has been modified by impurities which may not exceed 2.5%.

Article and photos: Courtesy Brazilian Government Trade Bureau, London.

Land Grading and Smoothing for Land Drainage

This paper has been abstracted from a paper by J. W. Rorden, of the Eversman Manufacturing Co., delivered before the North Atlantic section of the American Society of Agricultural Engineers.

SURFACE drainage is the removal of surplus water from the surface of agricultural land. The purpose is to rid land quickly of its excess water and prevent the soil from becoming too wet. The common use systems of surface drainage involve open ditches, drainage type terraces or 'bedding.' Land smoothing is the grading or planing by mechanical means of the land surface to eliminate or reduce elevated areas and fill minor depressions. It has definite application in conjunction with installation of surface drainage systems. It should be clearly understood that in discussing this subject we are talking about 'land smoothing' rather than 'land levelling.' We are not talking about making the fields level, but rather making them smooth so that the natural fall of the land can be utilised to best advantage in achieving surface drainage.

Land preparation

Land preparation actually consists of two separate phases. The first is 'land grading' or 'dirt moving,' which consists of moving the dirt from the high spots to the low areas, and results in an even grade over an entire field. The second is known as floating, smoothing, planing or finishing which, in all cases, must follow the grading work whether it be done by large or small equipment, and is the step which eliminates the minor surface irregularities. In some of the flatter areas of our country these 'minor surface irregularities' can lead to severe crop damage, since there is so little fall to the land that a ridge of a few inches can form a pond easily covering an acre or more. If water stands on that area for any length of time, crop damage cannot help but result. In many of the flat land areas a majority of the fields have enough natural slope to permit drainage if these slight ridges, holes and obstructions are ironed out. In most cases, a surprisingly small amount of dirt must be moved to allow the water to spread. There is, therefore, a large total acreage on which very little work is required in the way of either grading or smoothing considerably to improve drainage. On an extremely flat field which has a large pot hole it is not necessary entirely to fill the hole. If the ridges surrounding the low spot are smoothed and some of the dirt distributed in the low spot, the excess water will spread since the natural slope of the land will thus be utilised and the entire field can drain and dry uniformly.

Methods

There are various methods of accomplishing land grading work, depending entirely on the individual job. If the cuts are small, under 6 in., and the longer hauls are around 300 ft., then it is possible for this work to be accomplished with a land leveller or small scraper used with the tractor already on the farm. If the cuts are larger and the hauls longer then it may be more economical to hire a contractor to do the dirt moving job.

The second step in the land preparation job is smoothing, floating, planing or finishing, which should be done each year. Once the farmer has gone to the expense of providing a grade on his fields so they will drain it follows that he must keep them in this condition if he is to continue to get satisfactory results. The cost of the smoothing operation is negligible since he works the leveller directly into his regular farming operations. Although it is a point difficult to understand unless it is observed in the field, the leveller is actually a tillage tool and will prepare an excellent seed bed.

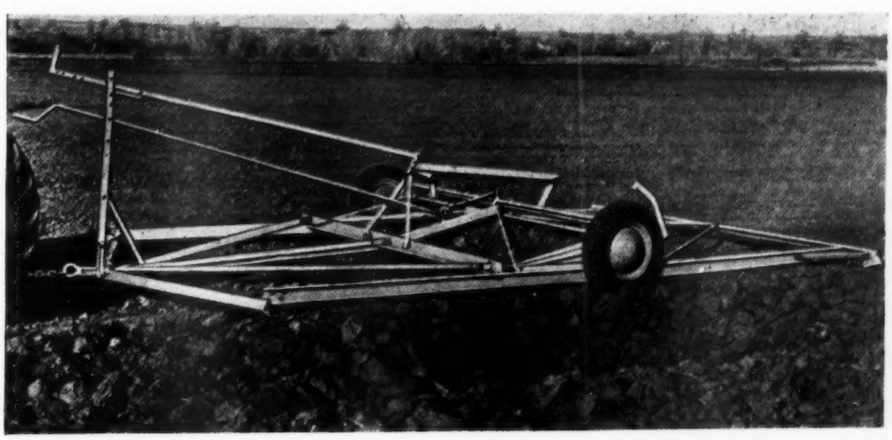
An example

At a Missouri experimental station in 1952, a yield test was conducted on two methods of seed bed preparation, one using a tandem disc and the other using a land leveller. The corn yields on these fields indicated an average difference of 5.1 bushels per acre in favour of the section on which the final seed bed was prepared by levelling. Of further importance was the fact that a more uniform stand was obtained on the smoothed area since there was considerably less variance among samples on the levelled section than on the disced area. This test is of double significance since there was insufficient rainfall during the 1952 crop season in this region to cause ponding and consequently there was no crop damage in the pot holes left in the disced plots even though they did not have proper surface drainage. Heretofore, the principal advantage of land smoothing on these fields had been considered to be the elimination of low areas which would pocket water and cause crop damage, and yet the yield was actually improved by using the leveller to prepare a superior seed bed, even though drainage itself was not a problem this particular year.

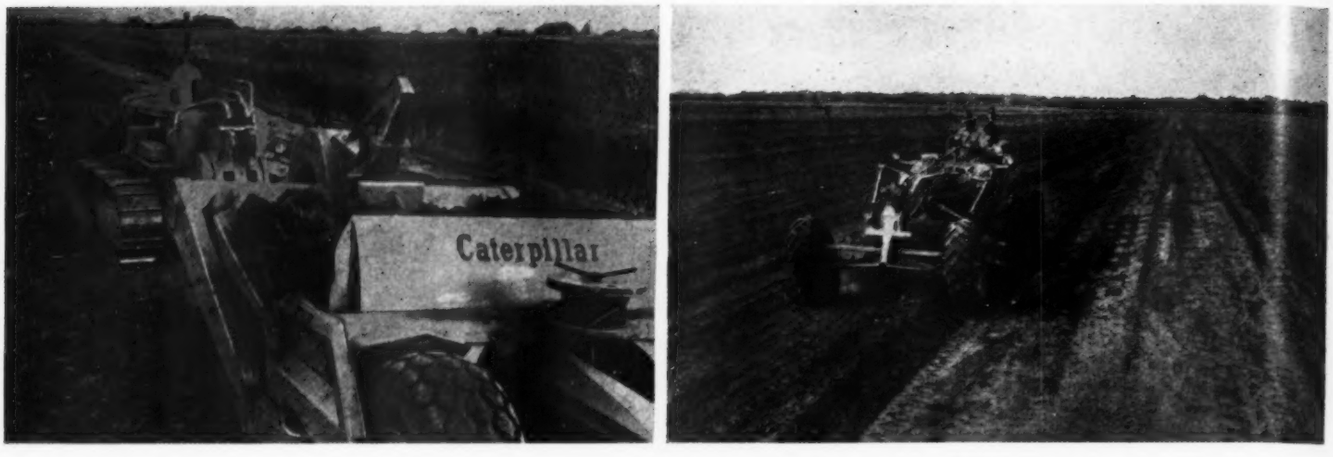
Costs

Two primary questions come up concerning grading, *viz.:* 'How much can I spend on grading?' and 'How can I possibly afford to cut off my top soil and dump it into a hole?'

The answer to the question of how much can be spent for grading is entirely dependent on the individual job and is



A land leveller in use for smoothing land to improve surface drainage



(*Left*) **Grading of sugar-cane cuts to improve surface drainage and hauling earth to fill low areas from spoil from canal excavation.** (*Right*) **Grading and crowning sugar-cane cuts with a Caterpillar motor grader to improve drainage**

almost in direct ratio to the potential productivity of the soil and the condition of the field, but depending, therefore, on the value of the land and the crops raised in any particular area, land grading costs are easily justified up to $50.00 per acre and more in many areas. On the subject of removal of top soil, remember that we are not talking about making large cuts and fills but moving a few inches at a time. This work can be done over a period of years and by fertilising there is no loss of production due to moving top soil.

Other operations

Grading and smoothing alone, of course, is not the entire answer to adequate drainage. This operation is an excess surface water correction, and in most cases must be supplemented with surface drainage.

Unless a field is small and there is a good slope to the land it is normally necessary to include several surface drainage ditches or drainage type terraces along with the land smoothing operation. A wide, shallow drainage ditch that can be crossed with all farm machinery has proved quite efficient in many of the flat land areas. This system of ' bedding ' has proved successful in many territories and is a definite step forward. However, there are countless fields to show that just because there is a drainage ditch for water to flow off the field it does not mean the water can jump from a pot hole 100 ft. away to the ditch. Only smooth, graded fields can carry the excess water to the ditch.

Rolling lands

Although we have so far discussed only the matter of drainage of flat fields, we should also consider rolling or hilly fields. As in the case of the flat areas, the object in rolling country is to spread the rainfall over the largest area possible. Elimination of washes and small gullies on the hillside will accomplish this objective and will remove the primary source of concentrated run-off which leads to erosion.

This work, if done every year, is not expensive and will prevent erosion from starting. With the gullies eliminated, the entire field can be worked as a unit instead of small lands divided by gullies. Before contour planting or construction of terraces, the land should be smoothed and gullies filled so that the terraces or contours can be run on gradual smooth slopes, thus eliminating goose necks and sharp bends that lead to water concentration and overflowing. After the terraces have been constructed, the floating operation should begin on the terraces so that the slopes are smooth and level. Here, again, the result is not only a uniform water disposal system but superior seed beds, larger field plots and, of course, much better operation from the other farm machinery will be obtained.

The farm size leveller can also be used to construct drainage ditches and grass waterways. Many farmers have been reluctant to drain their fields with waterways since they have always considered the work expensive. With the land leveller it is possible for the farmer, using his own tractor and a mouldboard plough, to start and construct these ditches by himself.

The leveller will prepare a better seed bed, will firm the soil without packing it, will leave a smooth, uniform surface which will hold sub-moisture near the surface in dry weather and give a well-drained seed bed in wet weather. The planter or drill will work more efficiently since all of the seed is planted at the correct depth, the resulting stand will be uniform and will mature at the same time since all seed comes up together and there are not water holes to retard part of the crop or to drown it out. Cultivation, of course, is easier and more efficient and weed removal more complete since the tractor is working on a smooth level surface. Possibly the greatest benefit of all comes from harvesting crops, such as soya beans, where a large portion of the crop is close to the ground. As much as 10% to 20% can be left unharvested in a field because of uneven surfaces. The farmer is not only harvesting all his crop when he operates on a smooth field, but he can also run his combine at higher speed without shaking it to pieces, and consequently has lower maintenance and repair costs.

Conclusion

It is not suggested that land smoothing is a cure for all soil and water problems facing the farmer or that other established practices may not be necessary. It is, however, believed that the next natural step in the improvement of agricultural programmes is the appreciation of the importance of the land surface itself, and that good land preparation can increase crop production just as much as any other single step so far taken.

Tea Growing in Hungary

Experiments with the domestication of tea plants in Hungary are stated to be making good progress. Six hundred plants grown at Nova, in Zala county, South-West Hungary, from Soviet Georgian frost-resistant hybrid types last year survived a hard winter and are this year reported to be growing sturdily. In June, 7,000 were planted at Nova.

Olive Farming in South Africa

The hillsides of the sheltered Paarl valley in the Western Province, about 40 miles from Cape Town, have become the centre of a still small but flourishing olive oil industry. The olive was first introduced to South Africa by Simon van der Stel around 1680, but was not developed on any scale until some 50 years ago. Based on experience in the olive groves of Italy, a thriving olive farm has been established at Huguenot by a family of Italian settlers. There are already some 10,000 olive trees on this and neighbouring farms and a small factory has been erected to produce oil from the olives, using modern machinery made in Italy.

Demand for the oil exceeds supply and farmers in the district are planting all available young olive trees, as the crop pays well on poor hillside soil which is otherwise practically worthless for agricultural use. Once the trees have become established they withstand the summer droughts well, especially when grafted on native stock. Winter rainfall in the district is ample to encourage healthy growth. Trees are usually planted from 25 to 40 ft. apart and can start to bear fruit in about three years, a commercial yield of olives being obtained after some six years, which is much sooner than with most European olive varieties. The picking season usually lasts from May to August.

Small growers in other parts of the Cape also send their olives to the Paarl factory for pressing and the future of this young branch of fruit farming in the Western Province is bright. Already over 100 tons of olives are harvested each season and when the young groves already planted reach maturity olive production will rise appreciably.

A different type of olive suitable for pickling is also cultivated to some extent in the Cape, but oil-producing varieties are most popular for large-scale planting because of the good price obtained for the expressed oil, which is of excellent quality and compares very favourably with some low grades of oil recently imported into the Union.

The only other district in South Africa where olives have been grown to any extent is in the Transvaal near Waterberg. However, climate and soil are quite suitable in many other parts of the country and olive trees could be expected to thrive if nursed through the initial stages of growth during times of severe drought.

Photo: Courtesy F. Costa and Son

Klein Drakenstein Valley with olive plantation in centre foreground

Proposed International Olive Oil Agreement

The establishment of an international agreement on olive oil production and trade was recommended by an international working party of experts on olive oil, meeting in Rome under the auspices of FAO from July 15 to 30. The object of the agreement would be to raise the efficiency in production and marketing of olive oil, improve quality, stimulate demand and ensure steady domestic and international supplies despite fluctuations which generally occur in alternate years in the size of the crop.

The working party's report will go first to the FAO Committee on Commodity Problems which established the working party to consider what international steps might be taken to improve the olive oil situation. If approved by the C.C.P., the report will go to the FAO Council. Upon approval by the FAO Council a general international olive oil conference of all interested countries might then be convened under the auspices of the United Nations to consider the proposed agreement.

This working party was composed of representatives from six interested countries: Spain, France, Italy and Greece as exporters, and the United Kingdom and Cuba as importers. A U.S. observer attended and an observer from the International Federation of Olive Culture.

The olive crop is subject to a strong two-year variation in production. In general, the alternating years of heavy and short crops have occurred simultaneously in all major Mediterranean producing countries. Most producing countries have set up some domestic system of storing part of the excess crop during the large-crop years, releasing the surplus in the next year. The lack of co-ordination between the systems and the difficulties encountered by the interested countries have prevented a stable international market for olive oil.

The working party's plan for international agreement proposes to deal with this through both technical and economic measures. The technical measures involve a co-ordinated drive to reduce the cost of olive oil production, processing and marketing by modernising practices and through research to discover still better methods. On the economic side an international olive oil council would be established to help olive-producing countries to convert their measures for stabilising supplies. No attempt would be made to control production, as the upward trend is in line with the growing demand. However, individual government operations in storing or releasing stocks would be co-ordinated in line with the recommendations of the international council. It is also suggested to establish an associated international olive oil fund to help finance certain storage operations.

South African Agricultural Developments

WE have recently received from our correspondent in South Africa the following report on developments in the Union:

Pineapple losses

Eastern Cape pineapple farmers have lost about £250,000 because of ' yellow spot,' which has crippled exports, Mr. W. G. Currie, a delegate to the congress of the Cape Eastern Province Coastal Agricultural Union, said in Port Elizabeth recently. He was speaking on a motion calling for immediate research into ' yellow spot,' which, he said, was a very serious scourge, mainly because farmers could not tell whether their crops were being affected. It was said that circulars had been sent to pineapple growers' associations asking them for a voluntary levy on their crops to start a fund for research.

Groundnut crop

On the basis of reports received at the beginning of August, the Division of Economics and Markets estimates the 1953-54 groundnut crop at 124,900 short tons of shelled groundnuts, compared with 100,700 short tons last season. The sunflower crop for the 1953-54 season is estimated at 45,000 short tons, compared with 53,700 short tons last season.

Fruit developments

Dr. R. I. Nel, director of the Western Province Fruit Research Station, told Cape fruit growers that the Hex River Valley is now producing fruit and export grapes to the value of more than £1,000,000 a year. This enormous development has taken place in recent years and the Hex River valley is now the most intensely cultivated farming area in South Africa—approximating to the densely populated farming areas of Europe. He warned his hearers, however, that unless soil fertility, water supplies and the improvement of existing grape varieties were studied carefully, a collapse might set in. He urged farmers to use the research facilities at their disposal and to work their farms scientifically. It is imperative to keep up to date. One of the greatest problems is the shortage of manpower.

During the past season, 6,047,701 packages of deciduous fruit were exported from the Cape, a record. The tonnage of all varieties of deciduous fruit increased from 51,807 tons during 1952-53 to 53,981 tons in 1953-54. Apple exports increased by 7,253 tons and grapes by 904 tons, but there was a drop of 5,815 tons for pears. Britain took 87% of the fruit exported from South Africa.

It is expected that about 6 million cases of citrus fruit will be shipped from the Union during the present season. If this total is realised it will represent a new record for the industry. The present record is 5,257,101 cases exported during the 1953-54 season. Competition in overseas markets is increasing. This year, for the first time since the end of the war, Britain is allowing entry to imports of citrus fruit grown in the United States, on condition that it is not subsidised. American citrus fruit, supported by a State subsidy, continues to be offered in competition with the South African product on the Continental market.

Natal sugar

The Natal sugar industry will have to make strenuous efforts to retain its position as one of the world's cheapest producers now that world sugar production is greater than the demand, said Mr. D. Saunders, chairman of the Tongaat Sugar Co. It was essential that the industry should be allowed a reasonable price for sugar in South Africa so that it would be encouraged to increase efficiency and develop its resources.

Referring to the ' disastrous succession of droughts ' in recent years, he said the first step is to introduce irrigation on dry lands as a drought insurance. The irrigation of certain lands would start this year and, if effective, would be extended considerably. New production records in both the milling and field departments were established last year. The price per ton for sugar cane during the current season would be lower because of the lower Commonwealth agreement price for sugar in 1954 and because of the deterioration in price of free-market sugars.

Tobacco prospects

A crop of 1 million lb. of Turkish tobacco in the Cape Western Province next season was envisaged by Mr. E. H. Nellmapius, president of the Western Province Turkish Tobacco Growers' Association, in his report at the recent annual meeting. Growers have been circularised not to extend their production next season. Mr. Nellmapius said he gathered some growers had seedlings damaged by weather, but in any event it was advisable not to build up manufacturers' stocks too fast. The inland consumption of Turkish tobacco last year dropped to 834,512 lb., which was 8% less than the previous year. Consumption in the first quarter this year also showed a downward trend. This was a serious threat to the industry and growers should concentrate on quality. On January 1, manufacturers had 1,578,245 lb. of Turkish tobacco on hand—sufficient for 22½ months. Drought last year caused the crop to shrink to 750,000 lb., which could be regarded as a mixed blessing.

Castor oil crop

Tobacco farmers in the Potgietersrust district, Transvaal, already doing well, are likely to benefit from a new industry which may bring them in an additional £600,000 annually. Apart from tobacco, most of them also reap good dividends from groundnuts and cattle, but the £600,000 will come from castor oil. A French firm with headquarters in Paris and representatives in Johannesburg, is said to have guaranteed the farmers in the district £33 10s. a ton for castor oil seed. Some farmers started to grow the crop this year and found it excellent as a rotation crop. A Springbok Flats farmer, planting maize after castor oil, got six bags of maize a morgen extra, but whether this will be true of all soils is a matter for further tests. Next year 200 tons of castor oil seeds will be planted in this district.

The yield is expected to be similar to the maize crop, 25 bags per morgen, and farmers should reap 1,600 tons. At £33 10s. a ton that will mean £600,000. The French firm is also reported to be prepared to give a contract for five years at £33 10s. a ton.

This may easily mean a thriving new industry for the Union. The castor oil plant is an annual and is planted in the same way as maize or groundnuts. Small crops have been grown in the Union, but fluctuating prices have hitherto retarded development.

There have been times when it has fetched £45 a ton, but it has also fallen to about £20 a ton. The guaranteed price and the fact that the plant may improve their lands have persuaded farmers to go in for large-scale tests. The manager of the Potgietersrust Tobacco Co-operative said that 90% of the tobacco farmers in the district are now planning castor oil production and the entire seed production this year will be used. If the experiment is successful, it is likely that after supplying the local market the surplus may be exported.

CORRESPONDENCE

Cocoa and Oil Palm Products in Nigeria

TO THE EDITOR

Dear Sir,

By selecting certain 1951 export figures for use in the second paragraph of their article the authors of ' The Cocoa Industry of Nigeria, the British Cameroons and the French Cameroons,' published in your July number, have provided a rather misleading picture of the relative importance of the cocoa tree and the oil palm in Nigerian economy. From the table below it will be seen that from 1948 (the year from which correct revised values are available for all three commodities) the value of cocoa exports has never exceeded that of oil palm products. The figure of £36,565,000 given in the article for cocoa exports in 1951 includes the duty twice over. In the Nigerian *Trade Report for the Year* 1951, from which the figure was no doubt obtained, it is stated (on page iii) that ' value includes the duty.' Value (including duty) on page 116 of that publication is given as £31,380,697 and duty as £5,184,567.

The real value of the oil palm to Nigeria is often unwittingly belittled in trade discussions for two reasons: firstly, because two commodities are produced and are listed far apart in trade statistics tables, and secondly, because the high internal trade in palm oil (more of which, it is believed, is consumed locally than is exported) is often overlooked by those assessing the ' importance ' of the various Nigerian crops.

World prices are now, of course, moving in favour of cocoa and there is no saying what the relative export values from 1954 onwards will be.

Yours faithfully,

C. W. S. HARTLEY,
Acting Director.

West African Institute for
Oil Palm Research,
Near Benin City,
Nigeria.
August 12, 1954.

EXPORT VALUES OF THREE NIGERIAN PRODUCTS

Year	*Palm Oil*	*Palm Kernels*	*Total Palm Products*	*Cocoa*
	£	£	£	£
1948	9,048,260	11,451,097	20,499,357	17,878,736
1949	11,910,091	16,912,575	28,822,666	14,697,228
1950	12,072,052	16,693,636	28,765,688	18,983,933
1951	12,948,943	20,059,297	33,088,240	31,380,697
1952	14,617,372	20,411,981	35,029,353	28,666,151
1953	12,980,477	22,184,668	35,165,145	24,857,889

Australian Grain Production

In recent years much attention has been paid to the problem of declining wheat acreages in Australia and many reasons have been advanced for the downward trend which has been so apparent since 1947-48. During the same period, there has been a steady increase in the area planted to coarse grains, *i.e.* barley, oats, maize and sorghum. The acreage of these reached a record level of about 4.6 million acres in 1952-53. This was more than 2 million acres more than the acreage devoted to coarse grains before the war and represented about 45% of the area under wheat in the same season. There was a slight reversal of this trend in 1953-54, but coarse grains maintained a much more prominent position relatively to wheat than formerly. This does not, of course, mean that the decline in wheat acreage is explicable solely in terms of a transference of land formerly devoted to wheat production to the cultivation of coarse grains. In New South Wales, where most of the decline in wheat acreages has occurred, there has been little, if any, increase in the coarse grain acreage. The greater part of the expansion has taken place in South Australia and Western Australia. In the former, where coarse grain acreage exceeded the wheat acreage for the first time in 1952-53, at least some of the increase appears to have been obtained at the expense of wheat acreage. In Western Australia, however, the wheat acreage has actually been increasing concurrently with the coarse grain acreage. The same applies in Queensland, which is only now emerging as an important grain-producing state.

Barley has accounted for nearly 40% of the 2 million acre increase in coarse grains above pre-war levels. In 1952-53, 1.4 million acres were planted, compared with 0.6 million acres between 1934-35 and 1938-39. Production totalled about 35 million bushels, as against less than 10 million bushels during the earlier period. The 1953-54 figure is expected to increase further to around 43 million bushels. Most of this spectacular expansion has occurred in South Australia, the major barley-producing state, which normally accounts for the bulk of the Australian output. There the acreage has increased by more than half a million acres. In Victoria, the second largest barley producer, the expansion has been much smaller. Oats in 1952-53 were planted over an area nearly 1 million acres higher than that planted in the pre-war years, and 1952-53 production reached a record level of 44 million bushels. This crop surpassed the previous record established in 1947-48 by 3 million bushels and exceeded the pre-war average output by as much as 27 million bushels. Latest figures indicate a decrease of about 10 million bushels for the 1953-54 season, but production is still well above average. The crop was grown fairly extensively in all states, but principally in Victoria, New South Wales and Western Australia. In 1952-53, the largest area planted was in Western Australia. However, yields were higher in Victoria and New South Wales and their harvests exceeded that of Western Australia.

In contrast to the other coarse grain crops, the area under maize has declined in recent years. This is a continuation of the downward trend since early in the present century. The leading state for maize growing at present is Queensland, where the area under the crop has been maintained at something more than 100,000 acres. The production of grain sorghum has also increased considerably in recent years. Before the war, the crop was grown on only an insignificant scale, but in 1952-53 a record area of about 196,000 acres was planted under it. Most of the post-war expansion has occurred in Queensland.

WORLD CROPS

IN OUR NEXT ISSUE there will appear the second part of the **Development of Spraying Machinery,** by R. J. Courshee. Eric Ford will describe **Forestry Policies in Africa,** and **Field Experience with Spray Nozzles in the Tropics** will be the subject of an article by F. L. Vanderplank. There will also be other articles and the usual features.

RESEARCH DEVELOPMENTS

Soil Conditioners and Soil Structure

THE effect of soil conditioners in improving the structure of soils continues to receive attention from research workers on both sides of the Atlantic, although it cannot be said that further experience has entirely justified the great show of enthusiasm with which their advent was hailed when the use of the polyacrylonitriles in this connection was first suggested.

In England, research at Rothamsted Experimental Station has continued to be prosecuted in relation to them without very encouraging results, for, although they are reported to have had a marked effect upon the physical condition of the soil, the effect on the yields of crops grown on soils treated with conditioners has been small. In America, there has been a vast amount of experimentation, but, according to a recent statement in the American *Journal of Agricultural and Food Chemistry*, ' soil conditioners have yet to make a big splash on the farm. ' Western soil scientists ' the journal continues, ' expect no great use of them farmwise in the near future.'

Soil structure

Meantime, discussions and research in regard to many aspects of soil structure continue to be pursued vigorously in the U.S.A. Recently, a conference was held at West La Fayette, Indiana, on the subject of soil microbiology, at which the subject of soil structure was discussed. At this, Dr. J. B. Page, of the Texas College of Agriculture, is reported to have remarked that so far there is no simple explanation of the phenomenon of soil aggregation. He urged the need for more research directed to elucidating the mechanisms involved. He pointed out that there seemed to be three possible mechanisms. The first of these, the effects of living organisms—fungi and bacteria—binding soil particles together may have been over-emphasised, in his opinion. The second factor, the presence of gelatinous organic matter in the soil, *e.g.* gums, resins, waxes and the like, which cement the clay particles together, is probably more important. There remains the third factor, which is that of the clay particles themselves adhering to one another and entrapping or bridging together larger particles. This, he suggested, might be the most potent influence and the main role of organic materials in the soil may be to modify these attractive forces of the clay particles.

On the other hand, Dr. W. P. Martin, of Ohio, comparing the effects of soil conditioners and microbial activities in conferring desirable physical characteristics on the soil, considered that a considerable percentage of binding material appears to be the result of the activities of soil micro organisms. Three classes of substances produce the binding effects observed. Of these, uruonid types of polysaccharides are very important, but cannot alone account for the aggregation observed in field tests. The discovery that naturally produced polysaccharides could stabilise soil aggregates led to the search for synthetics which would do the same thing but last longer in the soil by resisting metabolism by micro organisms.

Other speakers on the same subject emphasised the importance of proper handling of organic residues and the use of nitrogenous fertilisers in soil stabilisation; also the importance of having due regard to the character of particular soils and the climatic conditions.

Measuring soil aggregation

Elsewhere in the U.S.A., at the recent meeting of the American Association for the Advancement of Science in Pullman, Washington, methods of measuring soil aggregation were discussed. Last year the inadequacy of existing methods was pointed out. These still comprise wet sieving and measurement of the modulus of rupture as the most widely used, but some new methods are showing promise, notably measuring the turbidity of suspensions of soils by means of a spectrophotometer. Another method proposed by Dr. W. H. Gardner, of the Washington State College, depends on treating soil aggregates with a series of standard alcohol-water solutions with varying concentrations of alcohol. The same worker has proposed a mathematical approach to the problem and has evolved formulae relating rate of infiltration and of wetting of soils to the degree of aggregation.

A question which is uppermost in the minds of many workers is how far laboratory tests of this nature will work out when regarded in relation to soils in the field. It is reassuring here to learn that Dr. L. A. Richards has recorded that in California the results of measurements of modulus of rupture of soil samples in the laboratory have given results that co-ordinate well with crop yields in the field.

Aerial Spraying Against Tsetse Fly in Rhodesia

Southern Rhodesia's tsetse fly aerial spraying operation in the Urungwe Reserve, 60 miles from Karoi, failed because the wrong time of the year was chosen for spraying, but a more intensive operation is to be carried out. Three specially modified Piper Cruiser aircraft began a six-month spraying operation from their base at Karoi at the beginning of last December. Spraying was called off in March. The director of tsetse fly operations, Mr. J. K. Chorley, said that the wrong time of the year was chosen for the campaign. Rain and low clouds continually hampered spraying and the dense foliage of the trees prevented the insecticide from penetrating all parts of the area. Mr. Chorley thinks that winter spraying will be more successful. Another handicap to the last operation was the distance of the landing field from the spraying area. Five aircraft instead of three will be used for the next operation. A new airfield has been built and a 30-mile road out through the bush so that the base can be nearer the spraying area.

Arrangements for the operation have already begun and supplies and insecticide have been sent to Sinoia. Spraying is carried out by injecting the B.H.C. insecticide into the exhaust manifold of the aircraft. An entomological expert said that it would be impossible permanently to wipe out the fly by aerial spraying in any area as had been done in Zululand, because there was no isolated area of tsetse fly in Southern Rhodesia. Game shooting, bush clearing and dense settlement of the areas would have to be carried out as well, and no cattle could be allowed in for a long time. Apart from the heavy cost of spraying, aircraft cannot penetrate many of the Zambesi valleys which are infested with the fly.

Steel Fabricators Appointment

On September 15, Mr. J. H. Robbins, who has been assistant to sales manager Mr. E. T. Watkins of Steel Fabricators (Cardiff) Ltd. for the past 18 months, left England to take up an appointment as secretary to Steel Fabricators' Australian company in Melbourne. He was accompanied by his wife and son.

While Mr. Robbins's activities in Britain have been mainly ' inside,' his name is known to many Horn-draulic distributors who will be interested to know of his promotion.

NEW BOOKS

The Responses of Crops and Soils to Fertilisers and Manures

By W. B. Andrews. Second Edition. Pp. 463. Published by author at State College, Mississippi. 1954.

The first edition of this book appeared in 1947 and five further printings were called for; now with rapid post-war advances in U.S. fertiliser practice, considerable text revision has become necessary, particularly on the subject of liquid nitrogen fertilisers. Agricultural scientists who have read any of the author's contributions to journals will hardly need to be told that the book is remarkably comprehensive. Books on fertilisers are not such rare events as before the war, but this book is likely to be chosen as one of the best in U.S. libraries for a good many years to come. It is aimed at the average reader as well as at the technically trained reader, and chemical formulae have been avoided to the maximum possible extent; it is difficult to judge whether this simplification is actually useful, for the text has all the solidity and detailed coverage of a technical reference work. The average reader will need a strong latent technical outlook if he is to stay the course. This does not imply criticism of the book's writing—indeed, it is written with admirable clarity; but only technically-trained readers are likely to assimilate the full flow of data and detail that Mr. Andrews has brought together.

The order of nutrient treatment is unusual and is perhaps open to criticism. Most of the earlier chapters deal with nitrogen in direct use as a fertiliser or with its indirect effects on other factors of soil fertility; as a result it is only towards the end of the first half of the book that chapters dealing with responses to phosphorus and potassium make their appearance. This must surely tend to overemphasise the unilateral use of nitrogen. Surely the fundamental treatment of P and K should take precedence over such specialised aspects of N usage as ammonia solutions or the use of legume crops? Readers with limited pre-knowledge of fertilisers and plant nutrition may develop an unconsciously biased attitude towards a single nutrient of the major trio when it is given such marked precedence.

The new chapter on ammonia and N solutions deals not only with responses but also with methods of application and safety requirements; it will be most valuable in countries where these modern fertiliser practices have yet to be fostered. The chapter on 'Buying Fertilisers' sets none of the price economy of home-mixing against the better uniformity and condition that factory-mixed compounds must possess, and this criticism is strengthened when the brief and inadequate recommendations for making compounds on the floor are read. A chapter on fertilising fishponds is an unusual and welcome inclusion. In a book that covers most subjects with such generosity of data and detail, it is odd that the trace elements are dealt with so slightly and incidentally. The practical background of the book is predominantly American, and even regionally so inasmuch as cotton is so often chosen as the 'crop example.' This is likely to limit the reference value of the book in many other countries.

Most of these points of criticism are minor, however, and they are dwarfed by the general competence of the book as a whole.

D. P. HOPKINS

Field Crop Production: Agronomic Principles and Practices

By Harold K. Wilson and Will M. Myers. Chicago. Lippincott. 1954.

'The authors have attempted to assemble and organise in readily accessible form the latest known facts in principles and practices of field crop production.' After initial chapters on plant growth, climate, soils, cropping sequences and tillage operations, the greater part of the book is concerned with descriptions of the major crops of the United States of America, including grasses and forage legumes. The discussion of each crop includes consideration of its importance and distribution in the United States illustrated with maps; tables are also included to indicate the world distribution of each crop. The botany of each crop is described briefly and illustrated with line drawings or photographs. Each description usually includes also notes on the adaptation of the crop to particular environments, the varieties in common use, fertiliser practices, cultivation and management afforded to the crop. Fungal and insect pathogens are also described. The three final chapters of the book are concerned with weeds and weed control, crop improvement and the production of quality seed.

'This book is designed primarily for use as a text, and the insertion of questions at the end of each chapter is intended to guide the student in his study.' This quotation from the preface makes quite clear the aims of its authors in writing this book, and these aims are worth some discussion.

Teaching methods differ widely from university to university and it should be said at the outset that the all-embracing textbook with questions is particularly adapted to an American style of teaching. While it may be more important to teach a student that textbook statements are sometimes dubious than to persuade him to learn the contents of a first-class textbook, the latter may be the only choice available when classes are very large. Then the insertion of questions at the end of a chapter may sometimes be helpful, but where possible these should be designed to persuade the student to use his reasoning powers rather than just to test his memory.

The author of a textbook must clearly decide in advance on the academic standing of the student for whom he is writing, and if he assumes too much prior knowledge the book may have limited appeal; if too little then the book becomes a compendium of allied subjects. The authors of this book assume very little and the first part of this book has been given over to expounding basic sciences, particularly botany and soil science. For example, in a discussion of soils the term pH is explained. This involves the authors in a discussion of ions, ionisation and related phenomena. This would be unnecessary for students properly trained in elementary chemistry, yet is insufficiently detailed to provide an explanation of pH for those lacking fundamental training. This type of criticism can be made of most of the opening chapters. More important, however, are the number of misstatements which occur; for example, that chlorophyll α and β differ only in respect of one molecule of water, and the curiously misleading statement 'the anthers carry the pollen on the seed of the flower.' Of all these early chapters it may be said that compression and abstraction have made them valueless for teaching at any level except perhaps as revision practice for students who may need such mnemonics as 'C. Hopkins Cafe Mighty Good' to help them remember the essential elements for growth.

The chapters concerned with individual crops are of much higher quality, but here inaccuracies are still frequent. For example, in the 'Botany of Oats' it is stated that 'the inflorescence is known as a panicle being so arranged that the flower parts are spread out' and that the glumes adhere closely to the 'caryopsis or true seed.' In the chapter on maize is the

statement ' from the ovule there arises . . . the style.' Such inaccuracies are most undesirable in a student textbook.

The most valuable part of the book is the large section concerned with pasture and forage crops—but this could have been greatly improved by the introduction of an ecological approach to grassland management. This would have given more coherence to the subject-matter and at the same time introduced fundamental principles in place of *ad hoc* rules for management.

This book is clearly designed for and reflects the needs of those American universities which train large numbers of technical students. It is unlikely to have a wide appeal elsewhere.

JOHN L. HARPER

Food Administration in India, 1939-47

By Sir Henry Knight, K.C.S.I., C.I.E. Pp. 323. Stanford University Press $7.50. 1954.

Feeding India's enormous population has always been a problem; even in normal times, the margin between supply and demand of the four important grains, rice, wheat, millet and sorghum is so narrow that an overall shortage of 5% results in great hardship, while abnormal variation in supply, movement or imports may result in distress or disaster in extensive areas.

The comfortable theory appears to have been held in India that the war would restore prosperity to the Indian agriculturist without imposing price controls or Government interference with trade. However, when the Japanese invasion of Burma in 1942 denied India supplies of grain from that country, the Government of India were, perforce, faced with the necessity for control of foodstuffs. Efforts to control the situation which arose were not immediately successful, Burma was lost, the Japanese were on India's eastern frontier, there were widespread civil disturbances, and finally, the Midnapore cyclone in Bengal caused failure of crops and resulted in the death of 1½ million people in the Bengal famine.

A Foodgrains Policy Committee had already stated the policy which thereafter guided the Government of India in food administration, while an executive body, the Food Department, using every means to emphasise the need for equality of sacrifice throughout the country, gradually brought order out of chaos, obtained control of all grain and many other foods and necessities of life, became responsible for the movement of grain throughout India, developed a successful ' Grow More Food ' campaign, set up a technical service, organised the processing of foods and, against considerable opposition, carried into effect rationing of food over a wide area. In addition to normal requirements, supplies were needed for feeding the Indian Army, which eventually reached a total of 2 million men, gathered for the attack on Burma and the Far East. The Food Department, working in close liaison with the Army Department, arranged purchase and movement co-ordination for these goods.

It is amazing that all this was accomplished without previous preparation in a country roughly equal to Europe without Russia in size and population, with complications inevitable by the division of the country into 11 provinces and several hundred Indian states, with differences in race, language, religion and ways of life more varigated than in Europe, and during a period of far-reaching political and constitutional development. In addition, it was frequently difficult to procure agreement between provinces and states over the fair distribution of grain, or to obtain efficient application of orders and regulations designed to ensure an equable distribution of stocks throughout the country.

With the end of the war in Burma in 1945, India hoped for an improvement in food supplies and relaxation of controls. But this was not to be, for the supply conditions in 1946 were worse than in any of the war years and the country was threatened by widespread famine. Rainfall was irregular and in places insufficient, a tidal wave and heavy rain caused extensive damage to crops in some places, while a cyclone resulted in the loss of 400,000 tons of rice. A world food shortage made it difficult to obtain imports of the 3 million tons of grain needed at this critical period. There also appears to have been weakening of food control, caused, in great measure, by the hesitation of the Government of India in deciding whether or not to abandon control of grain, and failure to realise that, to ensure provision of sufficient food, there must be control over the supply, prices and movement not only of food grains, but also of various other commodities and services.

However, the lesson of 1943 had been learned; the controls were maintained, belts were tightened still further, and famine averted.

Sir Henry Knight, writing with intimate knowledge of these events, presents a book of absorbing interest, which is far more than an accurate, well documented and detailed history; he has provided India with a manual of practical value for the present and the future. Unhappily, food crises following disasters or crop failures appear to be India's heritage, and a recent disaster will be fresh in the reader's mind. The most serious consequences of such disasters, however, may be averted if the machinery of food control is kept oiled and the lessons so painfully learned in the early years of the war and in 1946, recorded in this book, are promptly and fearlessly applied.

D. H. GRIST

The Late Mr. T. Crosbie-Walsh

Mr. Thomas Crosbie-Walsh, F.R.I.C., editor of our sister journal, *Food Manufacture*, and a director of the publishers of WORLD CROPS, Leonard Hill Ltd., died on September 7 after a short illness. He was 74.

Mr. Crosbie-Walsh's life was divided between two main interests: chemistry and journalism.

In 1902, he went to South America on behalf of Borax Consolidated Ltd. as chemist, after which he practised as an analyst and consultant in Buenos Aires. In 1914, he was appointed chief chemist of Liebig's Extract of Meat Co. Ltd. He became an Associate of the Royal Institute of Chemistry in 1918 and a Fellow in 1923. After leaving Liebig's he joined Bovril Ltd. and for upwards of two years carried out intensive research work for them. Mr. Crosbie-Walsh then went to New Zealand to do research and established himself permanently in London in 1932 as a consulting food technologist.

His full-time activities in technical publishing began in 1937, when he joined Leonard Hill Ltd. as editor of *Food Manufacture*. During his career with this company he was, in addition, editor of *Food Industries Manual*, now in its 17th edition, and, for a time, editor of *Dairyman*. He was elected to the board of the company in 1949.

In an appreciation of Mr. Crosbie-Walsh in the October issue of *Food Manufacture*, Mr. W. Leonard Hill, chairman of the company, wrote: ' All his work was characterised by that touch of genius which has been described as " an infinite capacity for taking pains." . . . To any in the food industry it can be said: If you seek his monument, look around you in your libraries.'

His genial presence and wise counsel will be sadly missed by his colleagues on the editorial staff of WORLD CROPS and other journals in the Leonard Hill group.

FARM MACHINERY

Platypus Power Trailer

Tests have recently been completed of the new Platypus power-driven trailer for the Platypus 30 ' Bogmaster ' tracklayer manufactured by Rotary Hoes Ltd. It is stated that the tests showed that loads of 3 or 4 tons could safely be carried on the bog. Previously, the maximum possible load had been 15 cwt. It was demonstrated that the loaded trailer could be backed without any difficulty; this, too, has never before been possible on the bog.

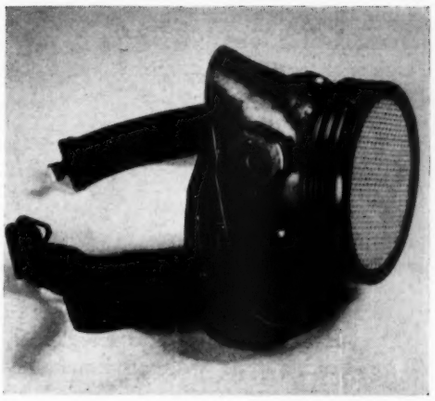
The machine is a power-driven trailer on 32-in. wide tracks, the main object of which is to provide a low ground pressure trailer for use behind the Platypus ' Bogmaster ' tractor. The drive is transmitted to the trailer from the rear p.t.o. shaft of the tractor through two universal joint assemblies supported by a telescopic tube, thus providing a large angle of turn between the tractor and the trailer. A selected ratio gearbox built into the trailer continues the drive from the tractor to the vehicle type rear axle through further universal joints and a torque tube enclosed drive to the differential pinion. The track assemblies are identical with those of the tractor and recoil springs are provided. Control to the selected ratio gearbox is conveniently placed for operation by the driver from his driving seat. To compensate for uneven ground levels between tractor and trailer the trailer body is pivoted over the track chassis about its centre and carries the drawbar to the tractor. The trailer is arranged to give a power drive in two tractor ratios.

'Pulsafe' Respirator

We have recently received details from Safety Products Ltd. of their new improved ' Pulsafe ' respirator. While in general lines this is similar to the Models Nos. 2, 3 and 22 which have been supplied for many years past, the new model incorporates some improvements.

The rubber facepiece has been redesigned and the entirely new moulds now in use produce a much more efficient and comfortable fit to the face. The new flexible wire spring is said to assure proper fit for every face contour and this, in conjunction with the headband adjustment, makes possible an airtight seal against the face with minimum pressure. The replacement of the headband is now more simple, as press-stud fastening has been adopted in place of wire clips. The screw front is now made from aluminium, as experience has shown that the plastic front fitted into the old model—introduced during the times of metal shortage—does not stand up well to the rigours of industry. Metal parts are now anodised.

Three variations are available: No. 2M, with a thin felt filter for protection against dry dust and paint; No. 3M, with a sponge (' Spontex ') filter suitable in hot, dusty atmospheres; and No. 22M, with a pad felt filter for protection against very fine dust. Protection in each case is against non-injurious industrial dusts. The complete respirator is 4 oz. in weight and the facepiece design provides the wearer with a clear, unobstructed vision with or without safety goggles.



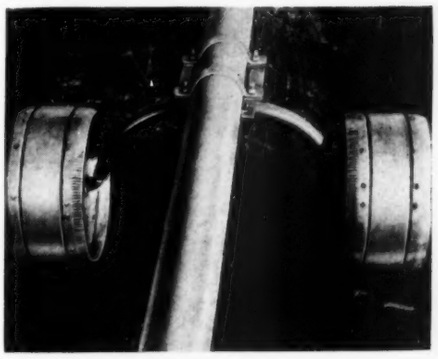
The ' Pulsafe ' respirator

Wheels on Sprinkler Laterals

Equipped with the new Ames ' Tow-a-Line ' wheels, revolving sprinkler lines ¼ mile in length and longer can be towed laterally by tractor, truck or Jeep from one watering position to another. This method of moving sprinkler laterals as a unit eliminates the time and labour normally needed for uncoupling, carrying and recoupling single pipe sections by hand.

Two types of wheels are normally used on a lateral: fixed-axle type and swivel type. Fixed-axle wheels, which move only in the same direction as the pipe, are used on all pipe sections except for two or three sections at each end of the lateral where swivel wheels are attached. These swivel wheels serve as ' casters,' permitting the operator to make sharp turns when towing the line in either direction.

The patented ball and socket construction of the Ames ' ABC ' coupler allows 22° of flexibility at each joint for freedom of movement on irregular fields and for turns while towing. Couplers are held secure during the towing and are protected from contacting the ground by a simple clamp-



These fixed-axle wheels are installed on all Ames ' ABC '-coupled pipe sections, except in two or three sections at each end of the lateral where swivel-type wheels are attached

The Platypus 30 ' Bogmaster ' tractor and power-driven trailer transporting 3 tons of sacked lime over a bad road

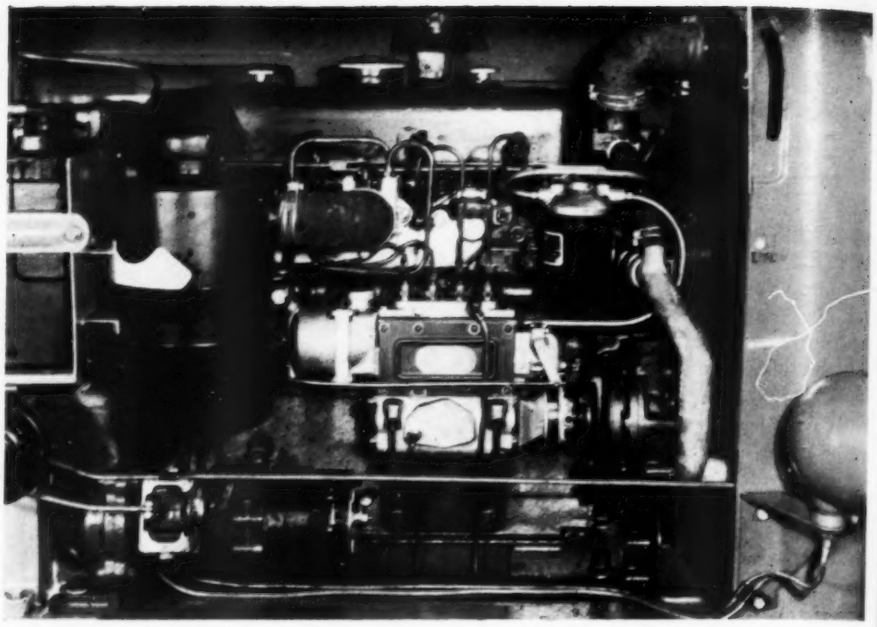
on hitch at each coupling. Quick-draining gaskets in the pressure-locking 'ABC' couplers automatically drain the line when the pressure is off.

B.M.C. Diesel Engine

The Nuffield Organisation has announced that a new B.M.C. designed and manufactured diesel engine will replace the Perkins P4 previously fitted in the Nuffield tractor.

The new engine is a four-cylinder, direct-injection type with an immensely strong five-bearing crankshaft. It has been under development for some years and field trials have proved very satisfactory. With a bore and stroke of 95mm. by 120 mm., the capacity is 3,402 c.c. This is ¼ litre larger than its predecessor, but the fuel consumption is about 10% less over the range. The power at the flywheel at maximum revolutions (2,000 r.p.m.) is 45 b.h.p. installed in the tractor, an increase of 6 h.p. The torque characteristics are ideal for a tractor engine.

The details of the design reflect the high standard of Nuffield engineering tradition. The crankshaft is fully counter-balanced; detachable wet liners give excellent cooling and ease of replacement; the cylinder head carries the valves, rocker gear and injectors and is completely water-jacketed around the ports and injector sleeves; induction and exhaust manifolds are mounted on opposite sides of the engine and a decompressor screw is fitted below each injector; the inlet valves are shrouded to promote air swirl; Simms injection equipment is used, comprising injector pump and pneumatic governor, the latter having a damping valve to eliminate engine surge; the 12-volt Lucas starter is of the pre-engaged pinion type and cold starting is remarkably good without any complicated heating devices; improved silencing and the modern design of the engine reduce the familiar 'diesel knock.'



Off-side view of the new B.M.C. diesel engine as fitted in the Nuffield universal tractor

Lighting Equipment for Agricultural Implements Standard

When the details of the new Road Transport Act of 1953, which affects lighting on agricultural implements, were announced in April this year the agricultural engineering section of the British Standards Institution anticipated the need of farmers for a simple standard fitment which would enable lamps and reflectors to be interchanged, without any modification, from one implement to another and the electrical connection made for lamps to different makes of tractor.

The co-operation of farmers (through the N.F.U.), of tractor and implement manufacturers and of makers of lighting accessories was readily given in this work. The main manufacturers represented on the B.S.I. Committee have agreed to adopt the basic principles laid down and have been taking the necessary action. The specification takes the form of a supplement to British Standard 1495, 'Tractor details,' and will be available as a separate document, if required, from the Institution.

To meet the need for a cheap but efficient and easily fitted attachment, practicable and in all cases suitable, a short metal pillar has been specified, to be fitted by the owner or maker in the required position on each implement, and a clamp, embodying the lamp mounting, to fit the pillar. This pillar is simply a ⅝-in. square-section bar which could be fitted by a smith or the farmer himself. The positional requirements of the Act are not repeated in the standard specification. The dimensions of the electrical plug for the lamp fitting have been standardised and those of the socket on the tractor follow from this.

'Vibraklon' Grain Cleaner

The 'Vibraklon,' a grain cleaner working on an entirely new principle, is now being introduced to this country by K. Bentley and Co. Ltd.

As the name 'Vibraklon' implies, its action is based on the principle of vibration. Its sieves do not oscillate, reciprocate or rotate; they vibrate, at a very high frequency and minute stroke. The vibration ensures, without the need of any mechanical device, that the apertures of the screens are kept absolutely clean by dislocating positively any particles which may get stuck in them.

Not only the screens used in the machine are subjected to vibration, but also the feed hopper and the fan, thereby ensuring even distribution of the material over the whole screen area. The effect of the vibrating principle is also shown by the extremely small overall dimensions of the machines for the given throughput, as smaller screen areas are now required due to the fact that a greater mass of grain can be passed through any point of the screens than is the case with the conventional type of screen surface.

The aspiration of the grain is looked after by a powerful fan and the grain falls through baffle plates in the aspiration area in order to give the grain the full benefit of air cleaning. The small impurities are then blown into twin-cyclons, 'Zentriklons,' which are designed to give absolutely dust-free operation, while their size is quite negligible compared with conventional cyclons. The quantity of air is regulated by two controls on the air intake side.

A great advantage of the 'Vibraklon' is that there is only one shaft and two ball bearings holding it, a feature which will certainly be appreciated when maintenance of the machine is contemplated. The power consumption is negligible; for instance, the 'Vibraklon,' with a throughput of about 10 tons per hour of combined grain, is driven by a 0.75-h.p. electric motor. The all-metal machines arrive ready to operate and there is no special installation problem.

WORLD CROP REPORTS

INDIA

Coconut plans. The Indian Central Coconut Committee (I.C.C.C.) has prepared, for inclusion in the Second Five-Year Plan (1956-61) of the Government of India, a proposed plan to make India self-sufficient in coconut requirements by increasing coconut cultivation. The new five-year scheme includes short- and long-term measures for increasing coconut production, provides for better statistics, suggests expansion of the coconut research stations, and proposes regulated marketing through producers' co-operative societies. Costs of the programme, estimated at Rs. 14,250,000, would be borne partially by the Indian Government and partially by major coconut producing states.

An output target of 4,257 million nuts annually is set for the end of 1960-61, an estimated 800 million more nuts than would be produced by the present rate of growth. Although 3,400 million coconuts were produced in India in 1952, over 1 million coconuts were imported mostly from Ceylon, supplemented by imports of 19,884 long tons of copra and 24,366 tons of coconut oil. Production at the present rate of growth based on the 1951 output would be an estimated 3,456 million coconuts at the end of 1960-61. However, taking into account increase in population and increased needs of the Indian soap industry, the estimated demand for coconuts and coconut products at the end of 1960-61 would be 4,257 million nuts.

The I.C.C.C.'s proposed short-term programme for stepping up production will entail the operation of demonstration plots to prove the efficiency of improved methods of manuring and cultivation, doing intensive educational work among growers, and providing an effective and extensive plant protection service. The bulk of the coconut growers of India, on whom will fall the ultimate burden of stepping up the production, are small-scale cultivators. Pests and diseases control measures, recommended by the I.C.C.C., will be encouraged, particularly in Travancore-Cochin State where the leaf and root diseases are responsible for considerable reduction in the yield of the coconut palms. Long-term measures will include steps to increase the area under coconut and to continue to supply quality coconut seedlings to growers.

Definite provisions for securing correct statistics on the coconut industry in India and for expansion of the two research stations are included in the proposed Second Five-Year Plan. Expenditures for these would be borne entirely by the Central Government; the balance of the costs would be shared equally by the Indian Government and the states.

Regulated marketing of coconuts and coconut products is recommended to assure growers of a better price for their produce. A co-operative system of markets would be established for copra with three or more regulated market centres in each of the major coconut-producing states. With each central market would be producers' co-operatives affiliated with marketing societies that would assure the grower of sufficient credit facilities and a fair price for his product based on quality. Furthermore, by utilising producers' co-operatives, kilns, market yards and warehouse facilities could be made available.

Over half a million quality seedlings are now distributed annually to growers under the operations of the first Five-Year Plan.

Foreign Crops and Markets

ENGLAND AND WALES

Agricultural report. Agricultural conditions in England and Wales on September 1, 1954 have been summarised in a report by the Ministry of Agriculture.

The weather during August made the harvesting of corn crops protracted and difficult. Estimates of yields per acre were generally below those of last year. Potatoes made good growth but widespread blight was reported. Root crops were satisfactory and average yields were expected. Haymaking had been very protracted and was not complete and the feeding quality of much of the crop will be below average. Cattle and lowland sheep had done well on the whole, but wet weather had been detrimental to some hill flocks.

Apart from a few fine days at the end of the month the weather during August was generally cool and wet throughout the period. Thunderstorms, with heavy rain, were frequent.

Corn crops. The harvesting of corn crops made a little progress during the month but a large proportion remained to be gathered.

Wheat. Lodging had occurred in most districts, particularly among the longer strawed varieties, but on the whole crops were standing well considering the weather. Some spring sowings were slow in ripening. Some sprouting had occurred, and takeall, eyespot and mildew were reported from several areas. On the basis of crop conditions at the end of August, the yield of wheat was forecast at 22.8 cwt. per acre as compared with 24 cwt. in 1953.

Barley had been badly lodged in many districts, but fair progress was made with cutting and combining. Some spring-sown barley had been slow to ripen. On the whole, the quality and condition of grain were reported to be fair to moderate. The yield per acre was expected to be 20.5 cwt. per acre as compared with a yield of 22.6 cwt. in 1953.

Oats. On the whole, fair progress was made with cutting and harvesting, but in many areas some difficulties were experienced with badly laid crops. Ripening had been slow in some districts. The yield was forecast at 18.8 cwt. per acre as compared with a yield of 21.2 cwt. in 1953. Mixed corn was expected to yield 19.2 cwt. per acre as compared with 21 cwt. in 1953. Rye had stood fairly well and cutting had begun. The yield was forecast at 19 cwt. per acre as compared with 19.6 cwt. in 1953.

Beans for stockfeeding were variable; lodging had occurred in many districts and chocolate spot had caused damage in some areas, but on the whole crops were satisfactory and a yield of 16.6 cwt. per acre was forecast as compared with a yield of 17.8 cwt. in 1953.

Peas for stockfeeding had suffered badly from the inclement weather and harvesting had been difficult. Many windrowed crops were deteriorating, and shedding and sprouting were reported. A yield of 10.9 cwt. per acre was forecast as compared with 15.9 cwt. in 1953.

Potatoes. Potatoes made good growth during the month, but blight was widespread—the attacks being severe in some areas. The haulms on many crops had been killed off by blight before the end of the month in many parts in the south of the country. On present prospects, the yield of second early and main crop varieties was expected to be 8.5 tons per acre, as compared with 9.3 tons in 1953, but blight might affect later estimates of yield.

Sugar beet. Sugar beet was generally healthy; the growth of tops had been excessive, but the yield per acre of roots was expected to be about average.

Roots. Turnips and swedes were healthy and vigorous but rather weedy in some areas. The combined yield per acre was expected to be about average. Mangolds made good progress, but weeds were troublesome. The yield per acre was expected to be about average. Fodder beet was generally satisfactory, although weeds were prevalent.

Hay. Haymaking had been very protracted over the whole country and in many districts was not complete at the end of August. Much of the hay harvested

was weathered and the feeding quality of a large proportion of the crop will be below average. The yields of hay from temporary grass and lucerne were forecast at 29.6 cwt. and 42.8 cwt. per acre respectively, as compared with 31.9 cwt. and 44.5 cwt. in 1953. The yield of hay from permanent grass was forecast at 20.6 cwt. per acre, as compared with 22.5 cwt. in the previous year.

Pastures. Grass was plentiful throughout August and the condition of pastures was satisfactory, although weeds were more prevalent than usual.

DENMARK

Crop prospects. Continual rain during the latter half of August caused further delay in grain harvesting. At the end of August only a small part of the crop had been brought in although most of it had been cut. It had not dried out properly and there would be heavy deterioration unless there was some dry weather during the next week or two.

Estimates of the condition of various crops on the dates shown are as follows (normal conditions are rate at 100):

	Sept. 1, 1954	*Aug.* 15, 1954	*Sept.* 1, 1953
Wheat	89	89	101
Rye	95	96	98
Barley	94	94	99
Oats	95	96	101
Mixed cereals ..	96	97	101
Pulses	88	92	98
Potatoes ..	97	98	96
Sugar beet (for feed) ..	86	88	85
Sugar beet (industrial) ..	89	91	106

INDONESIA

Rice production. Milled rice production in Indonesia is now estimated officially at 7,100,000 metric tons. This is larger than the 1953 crop by 300,000 tons, or 4.4%. The acreage will be up about 3.8%. The indicated increase in yield from 1,421 lb. of rough rice per acre in 1953 to an estimated 1,429 lb. in 1954 is attributable for the most part to the use of better seed, particularly the Bengawan variety developed by the experiment station at Bogor. Increases in planted areas come from new land brought into rice in North Sumatra and to some degree also in North Celebes. It is estimated that production in North Sumatra may amount to 550,000 metric tons of milled rice.

The prolonged drought of 1953 was for some time considered to be an important factor in holding down Indonesian rice production in 1954 because of the late planting of the crop. However, the rainy season of 1954 continued over a longer period than usual and apparently offset most of the expected loss in production.

During 1954-55, priority will be given to the rehabilitation of abandoned rice fields in South-East Borneo, followed by commencement of additional development in the area. Just how extensive this will be has not been announced as yet by the Indonesian Government, but with the limited funds available it is quite likely that rice production will not be materially increased.

The per capita consumption of rice in 1954 is estimated at about 194 lb. of milled rice, or slightly higher than that of 1953. It is assumed that with increasing availability of supplies this consumption will tend to rise.

PAKISTAN

Cotton. The area under cotton is to be further increased in Pakistan this year. About 400,000 acres of new land are expected to be brought under cotton cultivation in the Thal development area in the Punjab and the Lower Sind Barrage area in Sind next year. There will be more emphasis on the production of long-staple cotton to produce cloth of a finer quality.

TURKEY

Grain prospects. Grain crops in Turkey are forecast at a somewhat lower level than the record harvest in 1953. Climatic conditions during the winter and spring of 1953-54 were, in general, much less favourable than in the preceding three-year period; especially throughout the important producing Anatolian Plateau regions. Rains normally falling in September and October were light last fall over the plateau and inadequate for proper seed bed preparation and germination of fall-sown grains.

The sudden advent of unusually severe weather in late November impeded winter growth, with the severe cold and heavy snows continuing unbroken until March 1. The melting snows and early spring rains provided sufficient moisture to give plant growth a fair start and raised hopes that continued favourable weather during May and June would largely counteract earlier unfavourable conditions. Except for occasional scattered local showers, however, the central plateau area received no rain of consequence during May and June, and the current outlook there is very poor in comparison with that of the past three years. This region accounts for approximately half of the total smallgrain area.

The coastal regions of the Marmora, Aegean and Mediterranean Seas have had more favourable conditions, and good grain yields are reported. Harvesting was almost completed in this area in mid-July, in contrast with the late season in the Central region, where the bulk of the grain this season is not ready for harvest until after the middle of July.

No significant change from the 1953 total grain acreage is estimated. A small reduction may have occurred in foodgrains but offset by slightly larger feedgrains. On the basis of the present outlook, unofficial forecasts place the wheat crop at about 215 million bushels, compared with last year's record outturn of about 295 million. Although sharply below that record, the current forecast compares favourably with the long range average prior to 1951.

Producers are assured a market at relatively good prices for all their grains, through Government support programmes. Support prices to producers of wheat were recently announced at the same rates as in 1953. However, increases in prices are authorised for highest quality Anatolia white wheat, durum, barley, rye and oats, designed to encourage improvement in quality and increased production of durum and feedgrains, for which good export demand is anticipated.

A wheat crop of the size specified would still provide a surplus above the country's normal requirement, though not the sizable surplus of the past season.

ZANZIBAR

Clove crop. The 1953-54 crop in Zanzibar turned out to be the second largest on record. Pemba's contribution, some 88% of the whole, was a record for that island. Altogether some 1,281,185 frasila (20,019 tons) were either marketed or deposited with the Clove Growers' Association during the season. This very large crop brought in a gross return of about £5½ million to the growers.

The prospects for the current 1954-55 crop are a very small mwaka crop, mainly in Pemba, and a small *vuli* crop shared between the two islands. The whole seasonal crop is estimated to be about 3½ lakhs frasila.

Local market prices have been just over Shs. 200.00 per cental for the past quarter. The Clove Growers' Association has made no changes in its guaranteed buying prices for the next season, but the export duty on cloves was reduced from Shs. 162.00 to Shs. 66.00 on October 1 for the ensuing 12 months. Exports over the last quarter have been small, just over 1,000 tons, mainly because buyers were expecting the fall in the export duty. The bulk of the cloves exported went to India and Indonesia.